BULLETIN NO. 22, NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

IV.

PREPARED UNDER THE DIRECTION OF
L. O. HOWARD,
ENTOMOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

DIVISION OF ENTOMOLOGY.

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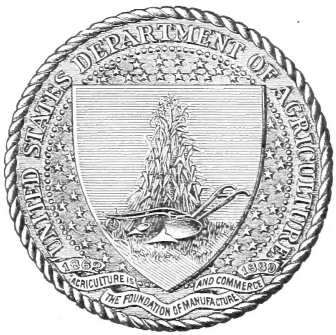

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1900.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., November 16, 1899.

SIR: I have the honor to transmit herewith the manuscript of a bulletin which contains matter similar to that published in Bulletins 7, 10, and 18 of the new series, namely, miscellaneous articles and notes which are too short for separate publication, but which are of sufficient importance to render prompt printing desirable. I recommend the publication of this manuscript as Bulletin No. 22, new series, of this Division.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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ILLUSTRATIONS.

PREFACE.

The present bulletin is the fourth of the new series of this Division containing miscellaneous short articles and notes. The article on the two most abundant Pulvinarias on maple gives a summary account of the life history and habits of, and remedies to be used against, the common cottony maple scale, a species which occasionally does great damage to shade trees in the Eastern United States and concerning which the Division has had no printed matter for distribution for a number of years, although a short account of the species was published in the Annual Report of the Department for 1884. The second part of this article brings together for the first time a full account of the maple-leaf Pulvinaria, a species which, although it has been considered identical with the last-named form, was rehabilitated as a distinct species by the writer last year. The second article illustrates the insects which, together with the newspapers, were responsible for the remarkable so-called "kissing-bug scare" of the past summer, and it is here published in response to an extraordinary demand for information by correspondents as to the actual truth of the newspaper stories. Reports on the destructive locusts in the West for the year 1899 are at this time of unusual interest on account of undoubted flights of the true Rocky Mountain locust, or "destructive grasshopper" (*Melanoplus spretus*), in certain portions of the Northwest. Mr. Chittenden's articles on the bronze apple-tree weevil and the food plants and injury of species of Agrilus are in continuation of his investigations on fruit and garden insects and of an investigation begun in 1898 on the pernicious bronze birch borer (*Agrilus anxius*), while his article on insects and the weather is an interesting and suggestive consideration of the insect conditions following the severe winter of 1898–99. Mr. Coquillett's two articles and that of Mr. Hemenway will be of interest to florists and greenhouse owners. The abstract of the paper by Dr. L. Reh on the scale insects found on American fruit imported into Germany is a summary of a somewhat extended series of observations, and is of interest to exporters of American fruits as showing the importance of sending abroad only perfectly clean fruit. The article by Mr. Felix G. Havens is a careful account of the excellent work done against injurious insects by the County Horticultural Commissioners of Riverside County, Cal., and is published for the information of officers in other

States engaged, or about to be engaged, in similar work. Mr. Busck's report on a brief trip to Puerto Rico is in line with other articles previously published. The trip was made at slight expense to the Division, owing to the courtesy of the United States Commissioner of Fish and Fisheries, and was practically a reconnaissance expedition to gain a preliminary idea of the abundance of destructive insects on the island and the probability of the entrance of new injurious species into the United States through increased commercial relations with the island. The insects collected on the trip have been named, but only the list of scale insects is published at this time.

Housekeepers will be interested in Mr. Tepper's Australian remedy for cockroaches and Dr. Fisher's clothes-moth remedy, while the information given about the recent spread of the Mediterranean flour moth will interest those connected with milling industries.

L. O. H.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

IV.

THE TWO MOST ABUNDANT PULVINARIAS ON MAPLE.

(*Pulvinaria innumerabilis* Rathv. and *Pulvinaria acericola* W. & R.)

By L. O. Howard.

The old and well-known cottony maple scale (*Pulvinaria innumerabilis* Rathv.) has been the subject of many published articles on account of its occasional extreme abundance and on account of the conspicuous damage which it does to maple shade trees in cities. It is true that the species of the genus Pulvinaria have not as yet been properly and systematically studied in this country, although several investigators are now engaged in such work, and it is altogether possible that more than one species is even at this late date confused under Rathvon's name.

This possibility is emphasized by the comparatively recent discovery by the writer that a form occurring upon maple leaves, and which was figured as long ago as 1868 by Walsh and Riley under the name *Lecanium acericola*, a name which was considered by J. Duncan Putnam and subsequent writers as a synonym of *Pulvinaria innumerabilis*, is in reality a perfectly distinct and thoroughly characteristic species, as will be shown in the second section of this article. So also the closely allied form occurring upon Osage orange to which the name *Lecanium macluræ* was given by Walsh and Riley in 1868, but which has since been considered to be identical with Rathvon's species, is now considered by Professor Cockerell to be distinct.

These forms being thus separated from *Pulvinaria innumerabilis*, there is reason to suppose that careful study may establish the occurrence of other species living upon maple and allied trees, and that in consequence the true *P. innumerabilis* may have a more restricted geographic distribution than is here given it. It is worthy of remark, moreover, that Professor Cockerell has described as at least a variety the form occurring upon maple branches in the State of Washington. This he calls *P. innumerabilis var. occidentalis.*

I. THE COTTONY MAPLE SCALE.

(*Pulvinaria innumerabilis* Rathvon.)

Original home and present distribution.—This is a scale insect native to the United States which was originally found by Dr. S. S. Rathvon at Lancaster, Pa. Later it was found by Walsh and Riley and other observers to be very abundant and occasionally very injurious in the Mississippi Valley. It is frequently noticed in the Northeastern cities, especially in Brooklyn, Philadelphia, Baltimore, and Washington. It has been sent to this office by correspondents in Massachusetts, Vermont, New York, Pennsylvania, New Jersey, Maryland, Virginia, North Carolina, Georgia, Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Kentucky, Tennessee, and Missouri, and what is apparently the same species has been received from Fort Worth, Tex., Omaha, Nebr., and from Idaho, Oregon, and Washington, as well as northern and southern California.

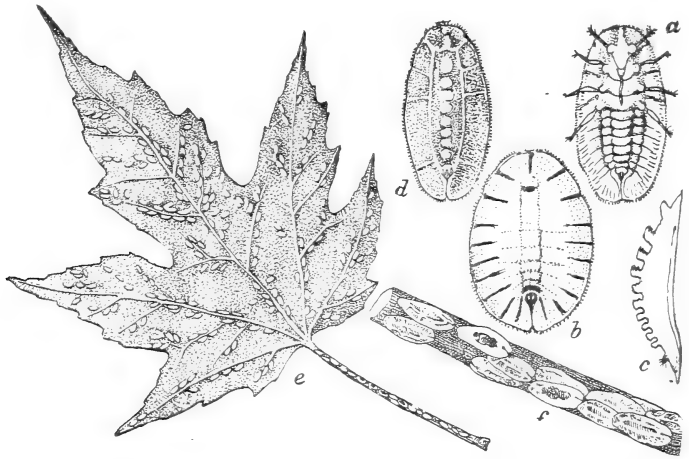

FIG. 1.—*Pulvinaria innumerabilis*: *a*, newly-hatched young; *b*, female, third stage, from above; *c*, same, from side; *d*, male, third stage; *e*, same, natural size, on leaf and petiole; *f*, same, enlarged, on leaf petiole showing two specimens parasitized—all greatly enlarged except *e* (original).

Food plants.—As its popular name indicates, this insect is generally found upon maple. It seems especially to thrive upon the so-called silver-leaf maple (*Acer saccharinum*), but it is also found upon Norway maple and the sugar maple, as well as upon *Acer dasycarpum*. It occurs abundantly upon the box-elder (*Negundo negundo*), and it or a very closely allied species is found upon the Osage orange (*Maclura aurantiaca*). During the summer of 1898 it was found at Washington by the writer occurring upon red mulberry (*Morus rubra*); and it has been received from Prof. George C. Butz, of State College, Pa., upon *Aralia japonica*. According to Prof. C. V. Piper, the Northwestern form (*occidentalis*) affects apple, pear, alder, willow, hawthorn, poplar, currant, and lilac, which diversity of food offers strong argument for

the specific distinctness of the so-called variety. Riley (Ann. Rept. U. S. Dept. Agr., 1884, p. 352) gives as the food-plants of this species: Maple, grapevine, Osage orange, oak, linden, elm, hackberry, sycamore, rose, currant, and Euonymus, and Putnam adds locust, sumach, wild grape, box-elder, beech, and willow. Careful studies of the forms occurring on all of these plants are, however, liable to indicate specific differences.

Habits and life history.—This species is a large naked scale insect, which is rendered conspicuous during the summer by a large white cottony-like egg mass at the end of the body of the female insect. Perhaps unnoticed previously, they suddenly attract almost everyone's attention in the month of June, for the reason that, although prior to that time they have been inconspicuous flat scales of much the same coloration as the bark, in June the brilliant egg mass is pushed out of the body. These insects appear frequently in enormous numbers on maple trees grown as shade trees, sapping their vitality, and thus becoming of much economic importance.

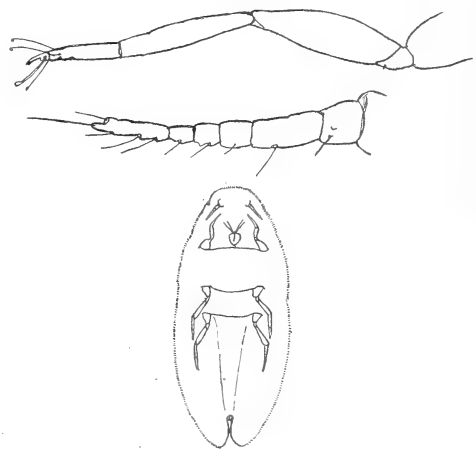

FIG. 2.—*Pulvinaria innumerabilis:* male larva, second stage, greatly enlarged, with antenna and leg above, still more enlarged (original).

The life history of this species was worked out with elaborate care by J. Duncan Putnam, of Davenport, Iowa. Mr. Putnam's paper was published in the Proceedings of the Davenport Academy of Natural Sciences (Volume II, December, 1879, pages 293–347), and was illustrated by two carefully etched plates. His descriptions of the different stages were so carefully drawn that descriptive details may be omitted from this article. The account of the life history which follows, however, is based upon observations made at Washington and upon notes taken by Mr. T. Pergande, the assistant in charge of the insectary at this office.

The young lice hatch early in the summer, usually in the month of June, but occasionally at least as early as May 22. The hatching period usually extends on into early July, but may last until August. They soon settle upon the ribs of the leaves, very rarely upon the twigs. They seem to prefer the lower surface of the leaves, but many settle at a later date on the upper surface. It has been noticed that those upon the lower surface seem to grow more rapidly than those upon the upper surface. In the course of a month they undergo a molt and begin to secrete a certain amount of wax from the dorsal surface of the

body, which gradually spreads in a more or less homogeneous layer over the surface. This first molt sometimes occurs at Washington by June 10, and a second molt by June 22.

From young larvæ which hatched on July 1, 1898, the first adult males issued on August 18, the full grown male scales being readily distinguished from the partly grown females by their narrower and more convex form. On reaching full growth the male larva assumes the propupal form within its scaly covering, and therefore without strictly casting skin. In a few days the propupa casts off its skin and assumes the true pupa form, which during its earlier stage is of a pale green color, becoming dark flesh color at a later date. The true pupal stage lasts only a few days, when the winged females appear, remaining a day or two below the scale before coming forth. The molted skins of the propupa and the pupa are seldom seen on the tree, as they are easily dislodged by the wind.

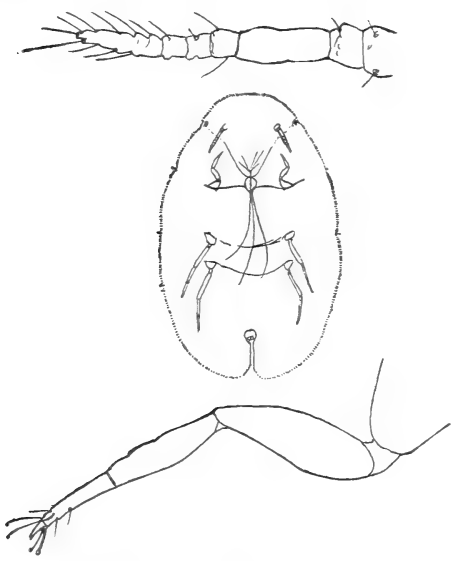

Fig. 3.—*Pulvinaria innumerabilis:* female larva, third stage, greatly enlarged, with leg below and antenna above, still more enlarged (original).

At the time when the males emerge the females have undergone two molts and are of a pale green color, marked with a brown dorsal stripe for the whole length of the body. The males copulate with the females late in August and early in September, and early in October those females which have escaped the attacks of parasites and other natural enemies begin to take their station on the nearby twigs. A change in color from green to buff is noted at this time and all are covered with a barely perceptible covering of waxy secretion. They are broadly oval and still quite flat. In this condition the females remain through the winter, the males having in the meantime died.

With the opening of spring, however, the females begin to grow rapidly, the eggs developing in great numbers, and by May, or as early as April 15 at Washington, the formation of the egg sac begins. The egg sac is composed of threads of fine wax, extruded from spinnerets near the end of the body. These threads become matted together and gradually form a large cushion under and behind the body of the female. Into this mass as it grows are gradually extruded the oval, light-colored, slightly reddish-yellow eggs, which, as above stated, hatch during June and July and on into August. The growth of the egg sac

pushes the hinder end of the body of the female upwards until when the sac is completed she is practically standing on her head, the body being at an angle from 45 degrees to nearly vertical.

The development of the insect during the summer of 1899 at Washington was more rapid than during 1898, and considerably more rapid than as described by Putnam for his Iowa region. The eggs, as indicated in a previous paragraph, commenced to hatch May 22; the young larvæ had begun to settle in numbers by May 26, the hatching continuing, however, for many days; on June 10 the first larvæ were observed to cast their first skins, which for some time adhered to the end of the body, resembling a small twisted string. By June 22 they commenced to cast their second skin, still retaining the same general appearance but having become considerably larger. The differentiation between males and females was plainly observable at this time, the males being narrower and more elongated. The dorsal secretion became noticeable at this time. On July 7 they were still apparently in the third stage, but some of the females had become marked with the peculiar purplish radiating lines characteristic of this insect. (See figure 1.) By July 26 some of the males had already cast a third skin, and were now in the last or fourth stage. The antennæ, which up to this time were 7-jointed, had now become 8-jointed. The male larvæ at this time still resembled the females to some degree, although they were smaller and narrower, and of a pale yellowish or whitish color, covered with a glossy covering. There seemed to be two propupa stages. After casting the second skin, the male larva loses its rostrum and its anal cleft, although the wing pads have not yet developed; the antennæ are stout and laid backward without perceptible points, and the end of the body is furnished with two long conical tubercles. After the third skin is cast, an apparent propupa stage is found which bears wing pads reaching to

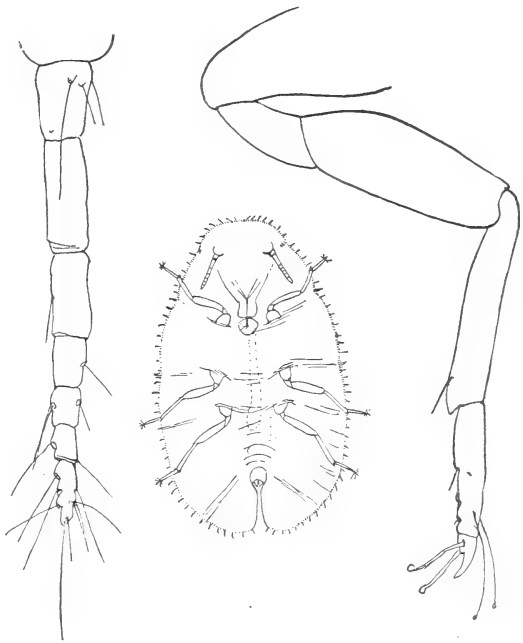

FIG. 4.—*Pulvinaria innumerabilis:* female larva, fourth stage, greatly enlarged, with leg at right and antenna at left, still more enlarged (original).

the abdomen; the claw of the tibia is lost, and between the posterior tubercles has appeared the stout, rudimentary style. The true pupa, specimens of which were also found as early as July 26, needs no description. The adult males began to issue on the same date for certain specimens, and as early as August 6 females had begun to migrate to the trunk; by August 21 all of the young females had left the leaves and migrated to the stem. It should be stated that these observations of 1899 were made upon a young potted tree in the insectary. The temperature, however, was practically the same as out of doors. So great had been the parasitism of the insect outside, that it was found necessary to make observations on potted trees under glass both in 1898 and 1899 in order to preserve the species for observation.

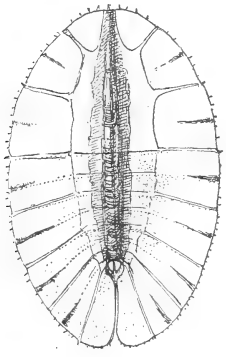

FIG. 5.—*Pulvinaria innumerabilis:* young hibernating female, from above—greatly enlarged (original).

Briefly then, there is one annual generation; the young hatch in early summer and settle upon the twigs; the males appear at the end of August and early in September; they fertilize the females, which migrate to the twigs, where they remain unchanged through the winter, rapidly swelling in the spring and forming the egg mass in early summer.

The insect is a notable one from its frequent sudden appearance in great numbers. After being almost unnoticed for a series of years it will appear in excessive numbers, apparently injuring shade trees to a considerable extent; then, without insecticide measures having been employed, it will as quickly disappear. These sudden appearances and disappearances are due very largely to fluctuation in numbers among natural enemies of the species, as will be shown in the following paragraph.

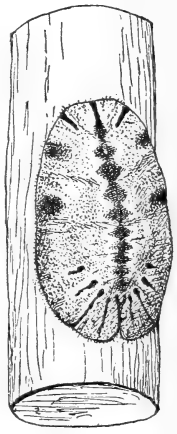

FIG. 6.—*Pulvinaria innumerabilis:* gravid female, greatly enlarged, before commencing to secrete egg sac in the spring (original).

Natural enemies.—Birds destroy the full-grown scales, although one would hardly suppose a mouthful of wax to be very palatable. The writer has often observed the English sparrow apparently feeding upon this species.

The usual predatory insects which feed upon other scale insects seem equally fond of this species, and the twice-stabbed ladybird (*Chilocorus bivulnerus*) is one of its especial enemies, as was long ago pointed out by Miss Emily A. Smith. The little insignificant ladybird beetle, known as *Hyperaspis signata*, is also a common predatory enemy of the species.

In 1879, in Washington, D. C., it was found that the most effective enemy of the scale was a predatory caterpillar described at that time by Professor Comstock as *Dakruma coccidivora*. This caterpillar flour-

ished upon twigs upon which the scales were closely massed together, and ate its way through the mass from one scale to another, spinning a close, rather dense web as it progressed. Each caterpillar in this way destroyed very many scale insects. The writer has always thought that it was due to this insect alone that the cottony cushion scale almost disappeared from the Washington shade trees in the close of 1879, and was never seen here again in any great abundance until, in the summer of 1898, nineteen years later, it became once more rather conspicuous, although by no means as abundant as in the former year. The Dakruma larva not only destroys the old and worn-out female Pulvinaria but devours her eggs and young larvæ with avidity. The caterpillars are very active, moving about freely within their silken passages. They were found to be full grown on June 24, spun their cocoons within the silken tunnel, and remained ten days in the pupal state. The moths issued from July 17 to August 13, soon thereafter ovipositing and lay-

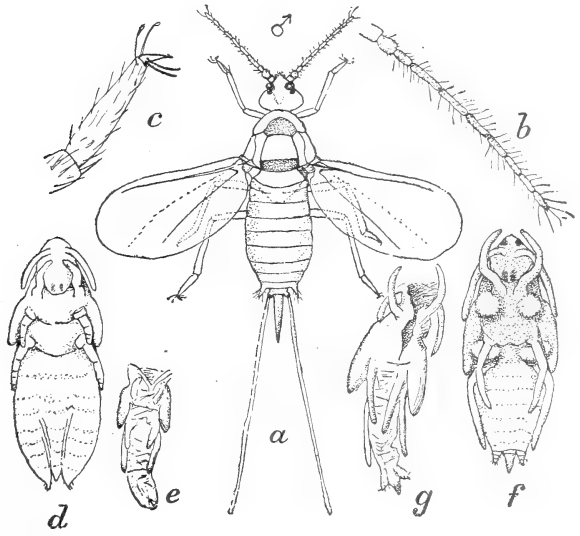

FIG. 7.—*Pulvinaria innumerabilis: a*, adult male; *b*, antenna of same; *c*, leg of same; *d*, second stage of pupa; *e*, cast skin of same; *f*, true pupa; *g*, cast skin of same—all greatly enlarged, *b* and *c* still more enlarged (original).

ing their eggs, which hatched in six days. Whether another generation of moths issues the same year has not been determined.

An even more important enemy of the cottony maple scale than the Dakruma larva or the ladybirds just mentioned is a minute Chalcidid fly known as *Coccophagus lecanii* (Fitch). This species, which has been reared from a number of different scale insects of the Lecanine group, is very widespread and appears frequently in astonishing numbers. It was due to this parasite that it was found almost impossible to carry the scale insects through the season at Washington in 1898; of the many thousands of scale insect larvae which settled upon trees under observation it is safe to say that much less than 1 per cent reached

full growth. During the months of July, August, and September they were stung by this little parasite, which laid its eggs in their bodies; soon afterwards they turned black, the adult parasites issuing from holes cut through the backs of their bodies. The development of the parasite was plainly seen to be very rapid, occupying certainly not more than two or three weeks, and there was therefore a succession of generations, with an increase in numbers in geometrical progression, until really the wonder is that a single scale insect escaped.

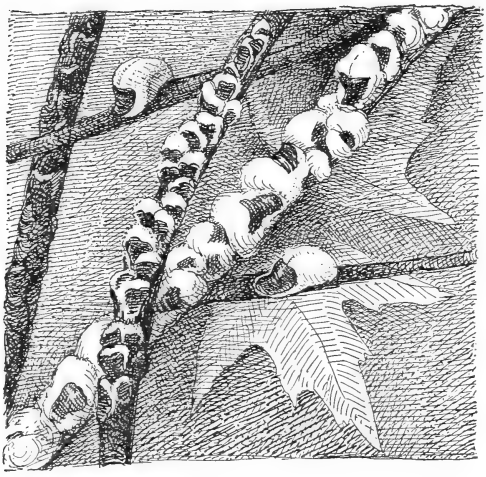

FIG. 8.—*Pulvinaria innumerabilis:* adult females in position on twigs, with egg sacs—natural size (original).

The writer had under close observation a branch of a large Norway maple tree growing in the Smithsonian grounds, which in June was fairly plastered with the egg sacs of the Pulvinaria, while in July its leaves were thickly speckled with newly settled young; in August he spent an entire morning trying to find a living scale insect, but without exception all which were found had been killed by this important parasite. The little Coccophagus even gained access to the Insectary. Potted maple trees stocked with the scale insects were discovered by them, and the scale was exterminated, although the little trees had been swarming with these scales, and although daily an assistant had picked off and crushed those which, through a change in color, indicated the presence of the parasitic egg or larva. It is this species probably more than any other which is responsible for the fluctuations in numbers of the cottony maple scale. As the writer has elsewhere pointed out in speaking of parasites of the grain plant-louse, it is probably only through the influence of a damp and rainy season, which prevents these active little Chalcidids from flying about to any extent, that the scale is able to overcome the effects of its attacks, enormously prolific as the Pulvinaria is.

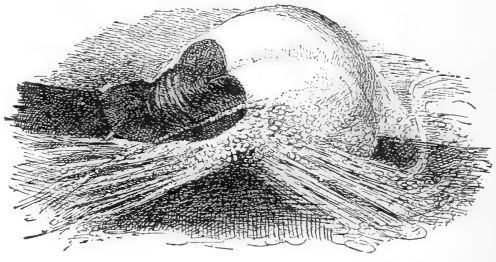

FIG. 9.—*Pulvinaria innumerabilis:* adult female, with fully extruded egg sac showing waxy filaments and eggs as they appear after being touched—enlarged (original).

Other members of the same subfamily of parasites, the Aphelininæ, have also been reared from the cottony maple scale. The species known as *Coccophagus flavoscutellum* Ashm., a more southern species than *Coccophagus lecanii*, does almost equally effective work in the more southern portion of the geographic range of the scale.

Another important parasite belongs to the subfamily Encyrtinæ, and has recently been named by the writer *Atropates collinsi* in honor of Mr. Lewis Collins, secretary of the Brooklyn Tree Planting and Fountain Society, who has had to fight the cottony cushion scale and has been greatly interested in its study. The Atropates was reared at Washington in 1889 and 1891 from females of *Pulvinaria innumerabilis* received from Mr. Collins and from L. H. West, of Roslyn, N. Y. All of the parasites issued late in July.

Still another parasite is the *Eunotus lividus* Ashm., a single specimen of which was reared March 4, 1899, from specimens of Pulvinaria received from Mr. Collins. This insect belongs to a curious and dis-

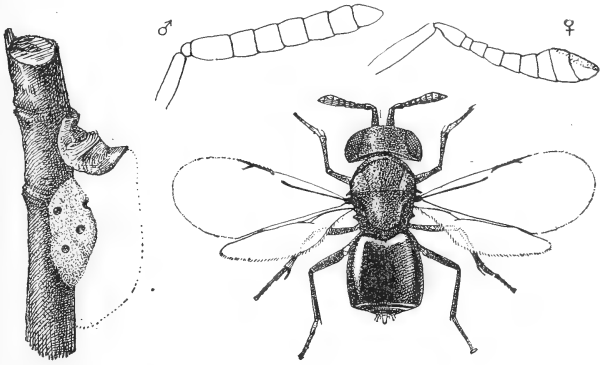

FIG. 10.—*Eunotus lividus*, greatly enlarged, with male and female antennæ above—still more enlarged, and cocoons under old scale at left, also enlarged (original).

tinct group of the subfamily Pireninæ, all of the species of which, from all of the specimens that the writer has been able to determine from oriental forms, are parasitic upon the large scale insects. Other specimens were reared April 12 and April 18 from old scales found upon maples on the grounds of the Department of Agriculture, and examination of the host insects showed a point of interest in the biology of the parasite. The early stages of Eunotus and its allies have not hitherto been observed, but these specimens issued from a small bunch of coarse but stout cocoons which had been spun under the body of the Pulvinaria.[1] A characteristic bunch of these cocoons is shown at fig. 10.

[1] Mr. Pergande has called the writer's attention to an interesting fact which shows that Fitch just escaped rearing Eunotus many years ago. In his Third Report on the Insects of New York, published in 1859 (p. 109), he describes *Lecanium ribis*, and states

Other parasites of this scale are *Aphycus pulvinariæ* How., described from specimens reared by Mr. Putnam in Iowa, and *Comys fusca* How., a common and widespread parasite of Lecaniine scales.

Remedies.—In view of the statement already made that the insect is rarely injurious in two consecutive years, it might seem as though no remedies were really necessary; but it has been found, in the experience of the city of Brooklyn, that the damage in a single season may be so great as to render long rows of shade trees unsightly. It is considered, therefore, to be the best policy, when the insect appears in great numbers, to await the hatching of the young and shortly thereafter to prune rather severely. In the case of especially valuable trees this pruning should be followed with either a summer spraying with a dilute kerosene soap emulsion or a winter spraying in the autumn with whale-oil soap in the proportion of 1 pound to 2 gallons of water. It is not difficult to determine whether the winter spraying is necessary by a careful examination of specimen twigs from trees in different parts of the city. Thus, in the winter of 1888–89, it was easy to see in Washington that the scale would be scarce the following summer, while in Brooklyn Mr. Collins was able to determine the exact localities in the city where insecticides would probably be necessary the following season by estimating the proportion of living scales.

II. THE MAPLE LEAF PULVINARIA.

(*Pulvinaria acericola* W. & R.)

Original home and present distribution.—This scale insect is also apparently a native of the United States, and seems to have been also originally found by the late Dr. S. S. Rathvon at Lancaster, Pa. He, however, while calling attention to the fact that there are probably two species of Pulvinaria to be found upon the maple tree, one of them occasionally being found upon the leaves, did not decide to establish any specific distinction between them.

In Volume I of the *American Entomologist*, however, Riley and Walsh, on page 14, figured a Pulvinaria upon a maple leaf received from B. W. McLean, of Indiana, to which they gave the name *Lecanium acericola*. This was considered by later writers, namely, J. Duncan Putnam and Emily A. Smith, to be synonymous with the *Pulvinaria innumerabilis* of Rathvon, and it was not until the writer in Bulletin No. 17, new series, of this Division, pages 57–58, called attention to the excellence of this figure and to the distinction between the insect represented and

that he reared from it several brilliant green parasites. Examining the type specimens of Fitch's *Lecanium ribis*, now in the possession of the United States Department of Agriculture, Mr. Pergande found that the scales had disappeared, but that the small bunch of Eunotus cocoons was attached to the twig in such a position that they were under the original scale. The minute perforations in these cocoons showed that the parasite mentioned by Fitch was a secondary parasite, probably of the genus Tetrastichus.

the true *Pulvinaria innumerabilis*, that its validity as a species was established. Although Walsh and Riley submitted no description, the figure is so characteristic as, under the accepted rules of zoological nomenclature, to carry the name.

The same insect is said by Walsh and Riley to occur at Davenport, Iowa, on the authority of Mr. Tiffany; and it has been received at this office from Prof. Hunter Nicholson, of Knoxville, Tenn., Mr. R. H. Pettit, of Michigan Agricultural College, who found it at Ithaca, N. Y., and from Mr. E. R. Malone, who found it abundant and injurious at

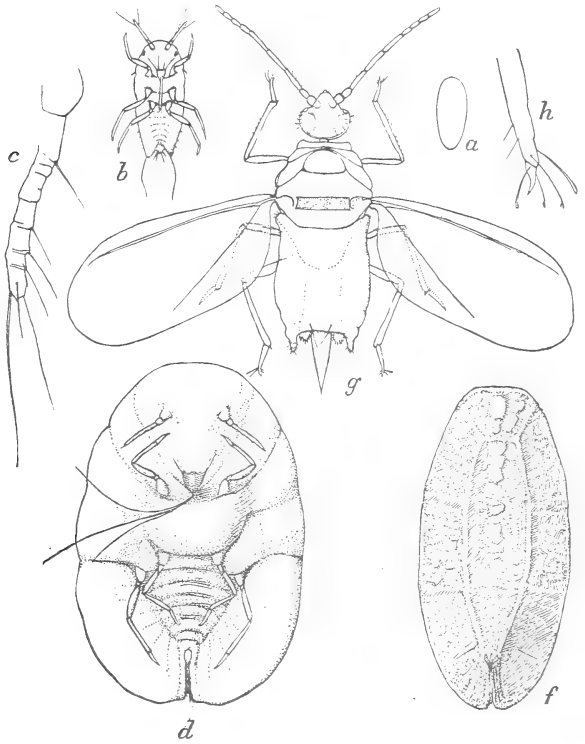

FIG. 11.—*Pulvinaria acericola*: *a*, egg; *b*, newly-hatched larva; *c*, antenna of same; *d*, female larva, early spring condition, from below; *f*, full-grown male larva; *g*, adult male; *h*, tarsus of same—all greatly enlarged; *c* and *h* still more enlarged (original).

Dothan, Ala. The writer also has been told by Dr. J. B. Smith that it occurs at New Brunswick, N. J. It also has been found in the eastern section of the city of Washington, D. C., by Mr. Busck, of this office. The species, therefore, has rather a wide range in the United States.

Food plants.—The only tree upon which the species has so far been found is the common silver-leaf maple, now known as *Acer saccharinum*. For purposes of study the insect was colonized in June, 1898, on some foreign maples on the grounds of the Department of Agriculture, *Acer*

platanoides, *A. pseudo-platanus*, and *A. palmatum*. They developed gradually upon these trees, but died out in the course of the year, which would seem to indicate that under ordinary circumstances the species will not thrive on any of these maples.

Habits and life history.—Occurring, as this insect does, exclusively upon the leaves of the maple during the summer time, it is necessary for its existence that it should vary in its habits and life periods from the species which we have just studied; in other words, there must be a migration in the autumn from the leaves to the twigs before the leaves fall, and there must be a return migration in the spring or early summer from the twigs to the leaves. In the case of *Pulvinaria innumerabilis*, only the one migration seems to be necessary, and that is only a partial migration, namely, from the leaves to the twigs in the autumn. It is only partial for the fact that many of the young settle and develop upon young twigs of the present year's growth.

In his announcement of the validity of the Walsh-Riley species in

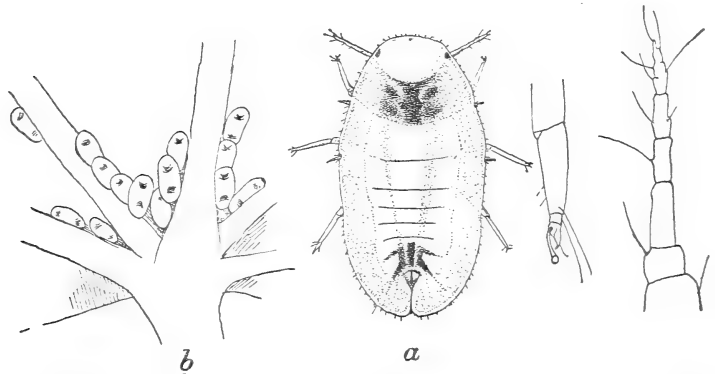

FIG. 12.—*Pulvinaria acericola*: *a*, larva of third stage—early hibernating female—with tarsus and antenna at right; *b*, larvæ of third stage on lower side of leaf, before migrating to twigs; *b*, enlarged; *a*, greatly enlarged, with tarsus and antenna still more enlarged (original).

Bulletin No. 17, new series, of this Division, the writer announced that he had the species under daily observation at Washington, and expected at an early date to publish its full life history. This statement was made in August, 1898, and from that time down to October, 1899, the species was under almost constant observation. Full notes on the life history, including descriptions of the different stages, have been made under the writer's direction largely by Mr. T. Pergande, and also by Mr. D. W. Coquillett, with occasional assistance from Mr. A. Busck; and from these notes and the writer's observations, the following summary of the life history of the insect is drawn up:

Eggs from specimens received from Knoxville, Tenn., began to hatch the end of June, 1898. Eggs from specimens received from Dothan, Ala., in 1899 began to hatch May 27. Eggs received from Knoxville, Tenn., June 6, 1899, were still unhatched. In Washington the secretion of the egg sac and the depositing of eggs in the mass of wax and fibers

composing the sac began late in May and continued gradually until nearly the middle of June. Larvæ began to hatch on June 13.

The newly hatched larvæ are of a very pale yellowish color, with median line slightly brownish, and the eyes dark purple. The antennæ are six-jointed, joints 3 and 6 longest and subequal in length, 4 and 5 also subequal and together about as long as joint 3; the two basal joints are also subequal, each about as long as joints 4 and 5, the first joint being stoutest. There is a bristle near the apex at the inner side of joints 3 to 5, and several at both sides and apex of the sixth joint. The digitules of the tarsi are extremely fine; those of the claws stouter and shorter; and all are capitate. Anal bristles are long and curved. The surface of the body is densely rugose, especially toward the sides; and the edge of the body is closely and sharply serrate.

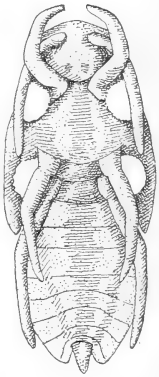

FIG. 13.—*Pulvinaria acericola:* male pupa, greatly enlarged (original).

On July 31 the larvæ commenced to cast their first skin. They were still of a very pale yellowish white color and almost transparent, though a very few specimens were marked near each end of the body with a pale purplish spot. In other respects they resembled the larvæ of the first stage except that they were a little longer and broader. The antennæ were still six-jointed, though somewhat longer than before; legs and their digitules as before; the bristles around the edge of the body were somewhat longer than in the first stage, but the anal ones were much shorter and but slightly longer than the others; all were situated on small cylindrical tubercles which, however, were slightly enlarged at the apex.

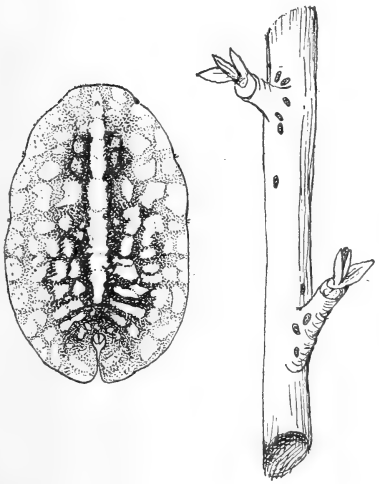

FIG. 14.—*Pulvinaria acericola:* late hibernating female, greatly enlarged; natural size on twig at right (original).

The growth from this time was very slow, and not until October was the second skin cast in the year of 1899. In 1898, however, a few larvæ of this third stage were observed as early as July 26. In 1899, many by October 15 had already left the leaves and had settled on the twigs. They were of a pale brownish yellow color, somewhat darker along the medio-dorsal ridge, and were characteristically marked with a large reddish, almost crimson, medio-dorsal spot on the prothoracic segment, and a similar spot just in front of the anal cleft. The eyes were minute and black. They were nearly twice as large as before, and at this time the sexes

could not be distinguished. As seen under the microscope the dorsal surface was finely granulate, with numerous transparent spots around the anal region and a row of seven or eight spots each side of the median ridge between the two reddish spots. The antennæ were now seven-jointed and gradually tapered toward the end, the third joint being somewhat the longest, joints 4 and 7 next, and subequal in length, and 5 and 6 shortest, nearly of equal length and together being a little longer than the seventh. Joints 4 to 6, each had a bristle-bearing notch, and the seventh had apparently three such notches on each side. The tarsal digitules were long, slender, and of equal length, while those of the claws were of unequal length; the shorter one was very stout, curved upward, and the other one was fine, almost straight and capitate, as were those of the tarsus. The hairs around the margin of the body seemed more numerous. By October 21 most of the larvæ had settled on the trunk and branches for hibernation.

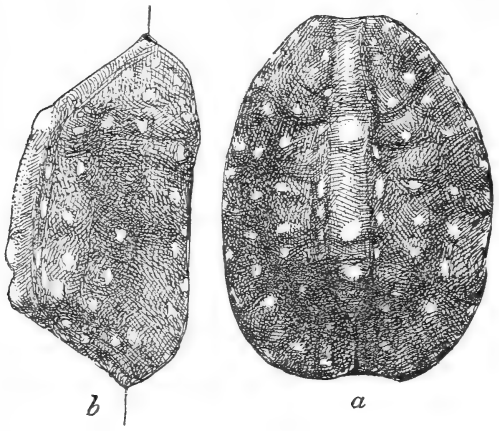

FIG. 15.—*Pulvinaria acericola*: *a*, a full-grown fertilized female, seen from above, in May before the secretion of the egg sac; *b*, same from side—greatly enlarged (original).

In October, 1898, the distinction between the males and females could be observed. The females were more broadly oval than the males, though all were very similar in coloration, possessing the large reddish spots just described. The antennæ of both were 7-jointed, though rela-

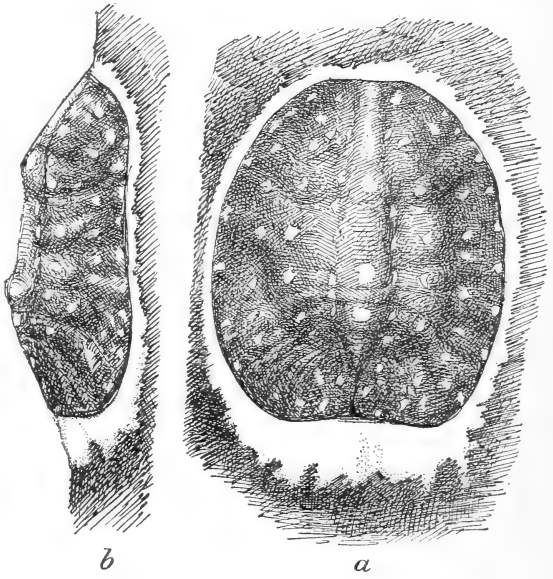

FIG. 16.—*Pulvinaria acericola*: *a*, full-grown female, from above, just beginning to secrete egg sac; *b*, same from side—greatly enlarged (original).

tively much shorter than in *P. innumerabilis*. About the time when the migration to the twigs began, late in October, the great majority of the larvæ were found on the underside of leaves, mostly along the ribs. A large number were also found on adjoining twigs, generally in and around the forks, in excresences, or near buds or other projections. At this time they run about quite actively in search of suitable places for hibernation. At this time is noticeable the delicate layer of waxy secretion which gives the insect a somewhat grayish appearance. This secretion is more or less distinctly broken up so as to form a series of waxy plates.

On November 1, 1898, practically all of the larvæ had settled for hibernation. Upon one branch about 18 inches long 150 larvæ were counted. They were most numerous on twigs and branches from one-eighth to one-fourth of an inch in diameter. None had appreciably increased in size, but their color was considerably darker and more

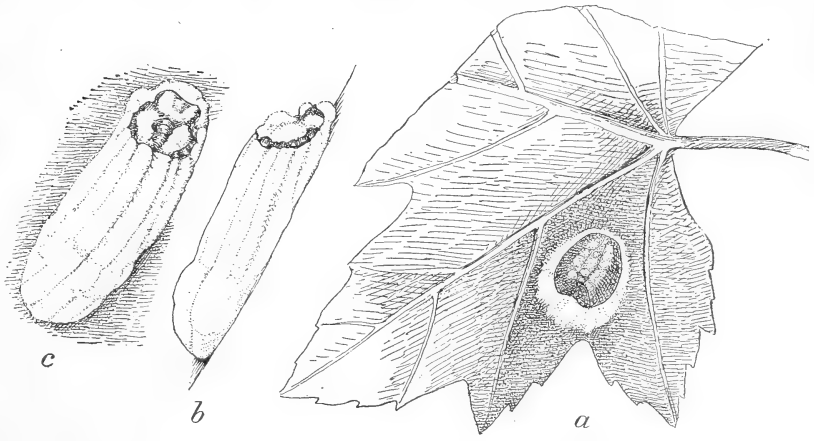

FIG. 17.—*Pulvinaria acericola*: *a*, full-grown female, from above, on leaf, with 24 hours' secretion of egg sac; *b*, same, with egg sac completed, from side; *c*, same, from above—enlarged (original).

dingy looking, harmonizing quite well with the coloration of the bark. This change in color seems to be due to the waxy secretion, which serves as a winter covering and also as a means of concealment. So close does this resemblance in color to the bark become that to the naked eye a twig thickly covered with the insects seems simply blistered or pustulate.

In December the conditions had changed but slightly. The larvæ were of a dingy, yellowish gray color, more or less spotted with purple, except the mediodorsal ridge, which was entirely yellowish. The whole surface was rather rough and covered each side with three more or less distinct rows of round or squarish scales of waxy secretion, looking like tortoise shell. On March 31 there had been practically no change.

By the 8th of April, on potted trees, were found both males and females. The largest females were about 3^{mm} in length by 1.8^{mm} in diameter. They were dark purple in coloration, with the median

ridge yellow, and were still provided on each side of the ridge with three to five rows of roundish, more or less projecting masses of white waxy secretion. The male insect was about 2.4mm by 0.8mm in diameter, and of the usual Lecanium shape. It was purplish brown and covered with a transparent layer of waxy secretion which was divided into three sections. The anterior and posterior sections were each about one-fourth of the length of the body, and the median sections about one-half of the length of the entire body. This median section was bordered at each side by a row of more or less confluent, squarish, white, flat, waxy scales. The general appearance is well indicated by fig. 11.

By April 22 the first male had transformed to a pupa, as shown in fig. 13. The color of the pupa is reddish brown, darkest dorsally, with the wing pads, legs, and antennæ paler; the anterior legs are directed forward and curved around the head; the others lie close to the body and are directed backward; the median pair reach to the fourth abdominal segment, and the posterior to near the end of the body. The wing pads reached slightly beyond the posterior margin of the second abdominal segment. The style is short and stout, and with a pointed lobe on each side. There is a small patch of woolly secretion externally near the coxæ of the anterior and median legs. The length of the pupa is 1.6mm. By April 28 the anal filaments of the male had begun to protrude, and by May 1 the adult had emerged. On May 18 large females with swollen bodies, indicating that impregnation had taken place, were found. They were 5.5mm in length by 3.5mm in diameter and 2mm high. They were of a dark purplish color, with a brownish-yellow mediodorsal stripe, ornamented on each side with three rows of small waxy scales or points, presenting the appearance as indicated in fig. 15.

On May 22, females began to move from the young branches out upon the twigs, and on May 23 one had reached the under side of a leaf and had commenced to form its ovisac. In the course of twenty-four hours the extruded white wax, forming nearly a complete circle about the insect, longer toward the anal end, had reached a width of about 1mm. Forty-eight hours later it had reached a length of 5mm and was distinctly divided from the first secretion by a deeply impressed line. The first wax extruded contained no eggs, but the real ovisac, comprising the last 4mm extruded, was full of eggs. The true ovisac has numerous transverse ridges which are divided lengthwise by two deep grooves. As the ovisac increased, the body of the female was tilted up more and more and became more shrunken in size. At the end of the third day the body had shrunken to a size a little more than half of its former dimensions, the abdomen having contracted into four transverse folds; the color had become lighter than at the beginning of the migration, and the extreme margin was pale yellowish. After two weeks the ovisac had become 10mm long by nearly 5mm broad,

tapering gradually toward the anterior end and presenting the appearence shown at fig. 17. It was composed of four strongly rounded longitudinal ridges.

On June 13 the larvæ began to hatch, and thus we have the life round completed.

Summarized, then, the life history is as follows: The eggs hatch in June from the ovisac of the females attached generally to the under surface of the leaf. The larvæ cast two skins, and in the autumn—late in October—crawl to the twigs, where they hibernate. In the spring they begin to grow. The males issue in May, fertilize the females, which toward the end of May migrate to the leaves, extrude their ovisac filled with eggs, from which the young begin to hatch in June once more. There is probably a spring moult of the larvæ, but this was not observed.

In none of the occurrences which we have noted above, except in the one at Dothan, Ala., has the insect been so numerous as to cause much damage. Mr. Malone stated in his letter of May 25, 1899, that one of his trees was in places literally covered with the insect, which had caused a number of twigs and smaller side limbs to die.

Natural enemies.—The only enemy observed in Washington is one of the ladybird beetles (*Hyperaspis signata* Oliv.), which was received in the larval condition from Knoxville, Tenn., feeding on the scale.

From the specimens of this scale collected by Mr. Pettit at Ithaca, N. Y., in 1893, he reared six parasites, which were sent to the writer for determination. They proved to be Chalcidids (*Aphycus hederaceus* Westw., *Aphycus flavus* How., *Coccophagus fraternus* How., *Pachyneuron altiscuta* How., and *Chiloneurus albicornis* How.) and a small fly (*Leucopis nigricornis* Egger). The same Coccinellid (*Hyperaspis signata* Oliv.) was also reared by Mr. Pettit.

Remedies.—There is always a chance that it may be desirable to use some remedial treatment against this insect, as at any time it is liable to increase in numbers and become more or less destructive. A strong whale-oil-soap wash during the winter will undoubtedly kill the hibernating individuals, and any treatment which will cause a premature falling of the leaves will be efficient as greatly reducing the numbers of the insect. The use of its leaves to a tree is practically completed some little time before the leaves really fall, and therefore knocking them off with a strong stream of water, or spraying with a strong kerosene-soap emulsion which may even kill the leaves, will do no harm at this time and will kill the insects.

THE INSECTS TO WHICH THE NAME "KISSING-BUG" BECAME APPLIED DURING THE SUMMER OF 1899.

By L. O. Howard.

In a paper read before the Zoological Section of the American Association for the Advancement of Science[1] the writer gave some account of the so called "kissing-bug" craze, which, originating in the city of Washington, in June, 1899, spread over almost the entire United States, and which, encouraged by the newspapers, resulted in one of the most interesting cases of widespread popular alarm arising from a comparatively insignificant cause which has occurred in the present scientific and matter-of-fact century.

While very many different insects have been brought to entomologists as undoubted specimens of the kissing-bug, including a large number of perfectly harmless forms, several species of heteropterous insects, each one of which is capable of inflicting a more or less severe wound with its beak, have helped to authenticate the scare, and it seems true that two of them, namely, *Melanolestes picipes* and *Reduvius personatus*, have been more abundant than usual this year, at least around Washington. They have been captured in a number of instances while biting people, and one or the other of them is undoubtedly responsible for the original cases in the Emergency Hospital at Washington, which gave rise to the first newspaper stories.

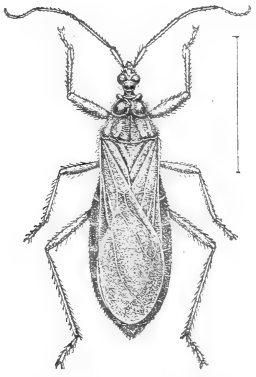

Fig. 18.—*Reduvius* (*Opsicætes*) *personatus*: About twice natural size (original).

The writer has thought it advisable to bring together an account of six of the most prominent of these bugs, which with greater or less frequency pierce the skin of human beings, and to illustrate them, as a matter of record.

Opsicætes personatus, also known as *Reduvius personatus* (fig. 18), and which has been termed the "cannibal bug," is an European species introduced into this country at some unknown date, but possibly following close in the wake of the bedbug. In Europe this species haunts houses for the purpose of preying upon bedbugs. Riley in his well-known article on "Poisonous insects," published in Wood's Reference Handbook of the Medical Sciences, states that if a fly or another insect is offered to the cannibal bug it is first touched with the antennæ, a sudden spring follows, and at the same time the beak is thrust into the prey. The young specimens are covered with a glutinous substance to which bits of dirt and dust adhere. They move deliberately, with a long pause between each step, the step being taken in a jerky manner. The distribution of the species as given by Reuter in his Monograph of the Genus Reduvius is: Europe to the middle of Sweden, Caucasia,

[1] Published in the Popular Science Monthly for November, 1899.

Asia Minor, Algeria, Madeira; North America—Canada, New York, Philadelphia, Indiana; Tasmania; Australia; from which it appears that the insect is already practically cosmopolitan, and in fact may almost be termed a household insect. The collections of the U. S. National Museum and of Messrs. Heidemann and Chittenden, of Washington, D. C., indicate the following localities for this species: Locust Hill, Va.; Washington, D. C.; Baltimore, Md.; Ithaca, N. Y.; Cleveland, Ohio; Keokuk, Iowa.

The bite of this species is said to be very painful, more so than the sting of a bee, and to be followed by numbness (Lintner). One of the cases brought to the writer's attention this summer was that of a Swede servant girl, in which the insect was caught, where the sting was upon the neck and was followed by considerable swelling. LeConte, in describing an insect of this species under the synonymical name *Reduvius pungens*, gives Georgia as the locality, and makes the following statement: "This species is remarkable for the intense pain caused by its bite. I do not know whether it ever willingly plunges its rostrum into any person, but when caught or unskillfully handled it always stings. In this case the pain is almost equal to that of the bite of a snake, and the swelling and irritation which result from it will sometimes last for a week. In very weak and irritable constitutions it may even prove fatal." (Proc. Acad. Nat. Sci. Phil., Vol. VII, p. 404, 1854–55.)

The second eastern species is *Melanolestes picipes*. This and the closely allied and possibly identical *M. abdominalis* (fig. 19) are not rare in the United States and have been found all through the Atlantic States, in the West and South, and also in Mexico. They hide underneath stones and logs and run swiftly. Both sexes of *M. picipes* in the adult are fully winged, but the female of *M. abdominalis* (fig. 19) is usually found in the short-winged condition. Prof. P. R. Uhler writes (in litt.): "*Melanolestes abdominalis* is not rare in this section (Baltimore), but the winged female is a great rarity. At the present time I have not a specimen of the winged female in my collection. I have seen specimens from the South, North Carolina and Florida, but I do not remember one from Maryland. I am satisfied that *M. picipes* is distinct from *M. abdominalis*. I have not known the two species to unite sexually, but I have seen them both united to their proper consorts. Both species are sometimes found under the same flat stone or log and they both hibernate in our valleys beneath stones and rubbish in loamy soils." Specimens in Washington collections show the following localities for *M. abdominalis:* Baltimore, Md., Washington, D. C., Wilmington, Del., New Jersey, Long Island, Fort Bliss, Tex., Louisiana, and Keokuk, Iowa.; and for *M. picipes:* Washington, D. C., Rosslyn, Va., Baltimore, Md., Derby, Conn., Long Island, a series labeled New Jersey, Wilmington, Del., Keokuk, Iowa, Cleveland and Cincinnati, Ohio, Louisiana, Jackson, Miss., Barton County, Mo., Fort Bliss, Tex., San Antonio, Tex., Crescent City, Fla., and Holland, S. C.

This insect has been mentioned several times in entomological literature. The first reference to its bite was probably made by Townend Glover in the Annual Report of the Commissioner of Agriculture for 1875, page 130. In Maryland, he states, *M. picipes* is found under stones, moss, logs of wood, etc., and is capable of inflicting a severe wound with its rostrum or piercer. In 1888 Dr. Lintner, in his fourth report as State entomologist of New York, page 110, quotes from a correspondent in Natchez, Miss., concerning this insect: "I send a specimen of a fly not known to us here. A few days ago it punctured the finger of my wife, inflicting a painful sting. The swelling was rapid, and for several days the wound was quite annoying." Until comparatively recently this insect has not been known to the writer as occurring in houses with any degree of frequency. In May, 1895, however, I received a specimen from an esteemed correspondent, Dr. J. M. Shaffer, of Keokuk, Iowa, together with a letter written on May 7, in which the statement was made that four specimens flew into his window the night before. The insect, therefore, is attracted to light, or is becoming attracted to light, is a night flyer, and enters houses through open windows. Among the several cases of bites by this insect, coming under the writer's observation, one has been reported by the well-known entomologist, Mr. Charles Dury, of Cincinnati, Ohio, in which this species (*M. picipes*) bit a man on the back of the hand, making a bad sore. In another case, where the insect was brought for our determination and proved to be this species, the bite was upon the cheek and the swelling was said to be great but with little pain. In the third case, occurring at Holland, S. C., the symptoms were more serious. The patient was bitten upon the end of the middle finger, and stated that the first paroxysm of pain was about like that resulting from a hornet or a bee sting, but almost immediately it grew ten times more painful and a feeling of weakness followed with vomiting. The pain was

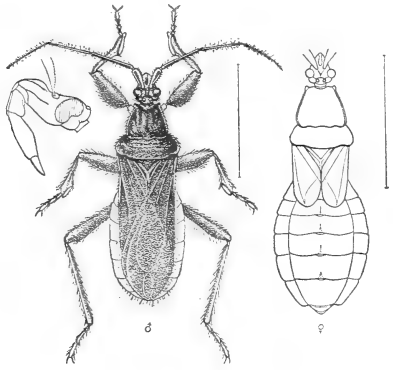

FIG. 19.—*Melanolestes abdominalis:* ♂, adult male; ♀, female; head and piercing beak at left of male above—about twice natural size (original).

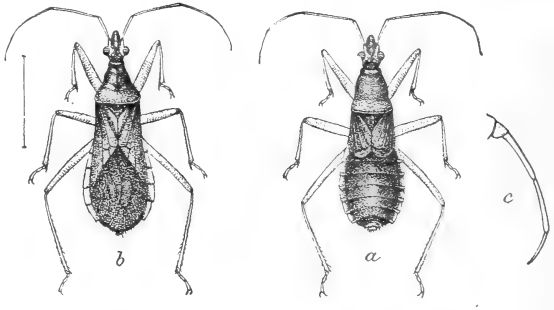

FIG. 20.—*Coriscus subcoleoptratus: a*, short-winged female adult (brachypterous form); *b*, winged female; *c*, piercing rostrum, seen from side, twice natural size (original).

felt to shoot up the arm to the under jaw, and the sickness lasted for a number of days. A fourth case, at Fort Bliss, Tex., is interesting as having occurred in bed. The patient was bitten on the hand with very painful results and bad swelling.

The third of the eastern species, *Coriscus subcoleoptratus* (fig. 20), is said by Uhler to have a general distribution in the Northern States, and is, like the species immediately preceding, a native insect. There is no record of any bite by this species, and it is introduced here for the reason that it attracted the writer's attention crawling upon the walls of an earth closet, in Greene County, N. Y., where on one occasion it bit him between the fingers. The pain was sharp, like the prick of a pin, but only a faint swelling followed and no further inconvenience. The insect is mentioned, however, for the reason that occurring in such situations it is one of the forms which are liable to carry pathogenetic bacteria.

There remain for consideration the Southern and Western forms, *Rasahus thoracicus* and *R. biguttatus*, and *Conorhinus sanguisuga*.

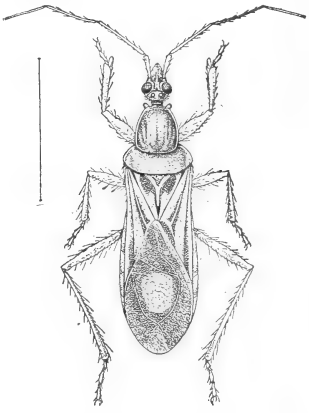

FIG. 21.—*Rasahus biguttatus:* adult, once enlarged (original).

The two-spotted corsair, as *Rasahus biguttatus* (fig. 21) is popularly termed, is said by Riley to be found frequently in houses in the Southern States and to prey upon bedbugs. Lintner, referring to the fact that it preys upon bedbugs, says: "It evidently delights in human blood, but prefers taking it at second hand." Dr. A. Davidson, formerly of Los Angeles, Cal., in an important paper entitled "So-called Spider Bites and their Treatment," published in the Therapeutic Gazette of February 15, 1897, arrives at the conclusion that almost all of the so-called spider bites met with in southern California are produced by no spider at all, but by *Rasahus biguttatus*. The symptoms which he describes are as follows: "Next day the injured part shows a local cellulitis with a central dark spot; around this spot there frequently appears a bulbous vesicle about the size of a 10-cent piece and filled with a dark grumous fluid; a small ulcer forms underneath the vesicle, the necrotic area being generally limited to the central part, while the surrounding tissues are more or less swollen and somewhat painful. In a few days with rest and proper care the swelling subsides, and in a week all traces of the cellulitis are usually gone. In some of the cases no vesicle forms at the point of injury, the formation probably depending on the constitutional vitality of the individual or the amount of poison introduced." The explanation of the severity of the wound suggested by Dr. Davidson, in which the writer fully concurs, is not that the insect introduces any specific poison of its own, but that the

poison introduced is probably accidental, and contains the ordinary putrefactive germs which may adhere to its proboscis. Dr. Davidson's treatment was corrosive sublimate—1 to 500 or 1 to 1,000 locally applied to the wound, keeping the necrotic part bathed in the solution. The results have in all cases been favorable. Uhler gives the distribution of *R. biguttatus* as Arizona, Texas, Panama, Para, Cuba, Louisiana, West Virginia, and California. After a careful study of the material in the United States National Museum, Mr. Heidemann has decided that the specimens of Rasahus from the southeastern part of the country are in reality Say's *R. biguttatus*, while those from the Southwestern States belong to a distinct species answering more fully (with slight exceptions) to the description of Stål's *Rasahus thoracicus*. The writer has recently received a large series of *R. thoracicus* from Mr. H. Brown, of Tucson, Ariz., and had a disagreeable experience with the same species in April, 1898, at San José de Guaymas, in the State of Sonora, Mexico.

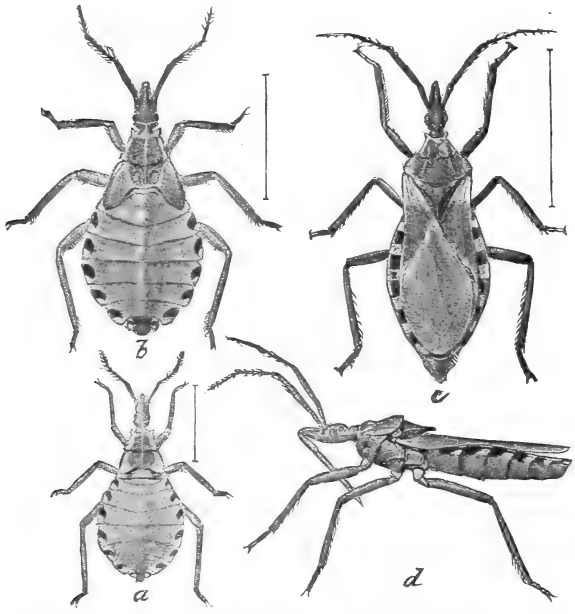

FIG. 22.—*Conorhinus sanguisuga*: *a*, first pupal stage; *b*, second pupal stage; *c*, adult bug; *d*, same, lateral view—all enlarged to same scale (from Marlatt).

Perhaps the best known of all the species mentioned in our list is the blood-sucking cone-nose (*Conorhinus sanguisuga*) (figs. 22 and 23). This ferocious insect belongs to a genus which has several representatives in the United States, all, however, confined to the South or West. *C. rubrofasciatus* and *C. variegatus*, as well as *C. sanguisuga*, are given the general geographical distribution of "Southern States." *C. dimidiatus* and *C. maculipennis* are Mexican forms, while *C. gerstæckeri* occurs in the Western States. The more recently described species, *C. protractus*, Uhl., has been taken at Los Angeles, Cal., Dragoon, Ariz., and Salt Lake City, Utah. All of these insects are bloodsuckers and do not hesitate to attack mammals. LeConte, in his original description of *C. sanguisuga* (Proc. Acad. Nat. Sci. Phil., Vol. VII, p. 404, 1854–55), adds a most significant paragraph, which, as it has not been quoted of late, will be especially appropriate here: "This insect, equally with the former (*see* above), inflicts a most painful wound. It

is remarkable also for sucking the blood of mammals, particularly of children. I have known its bite followed by very serious consequences, the patient not recovering from its effects for nearly a year. The many relations which we have of spider bites frequently proving fatal have no doubt arisen from the stings of these insects or others of the same genera. When the disease called spider bite is not an anthrax or carbuncle, it is undoubtedly occasioned by the bite of an insect, by no means, however, of a spider. Among the many species of Araneidæ which we have in the United States, I have never seen one capable of inflicting the slightest wound. Ignorant persons may easily mistake a Cimex for a spider. I have known a physician who sent to me the fragments of a large ant, which he supposed was a spider, that came out of his grandchild's head." The fact that LeConte was himself a physician, having graduated from the College of Physicians and Surgeons in 1846, thus having been nine years a doctor of medicine, renders this statement all the more significant. The life history and habits of *C. sanguisuga* have been so well written up by Mr. Marlatt, in Bulletin No. 4, New Series, of this Division, that it is not necessary to enter upon them here. The point made by Marlatt that the constant and uniform character of the symptoms in nearly all cases of bites by this insect indicate that there is a specific poison connected with the bite deserves consideration, but there can be no doubt that the very serious results which sometimes follow the bite are due to the introduction of extraneous poison germs. The late Mr. J. B. Lembert, of Yosemite, Cal., noticed particularly that the species of Conorhinus, occurring upon the Pacific coast, is attracted by carrion. Professor Toumey, of Tucson, Ariz., shows how a woman broke out all over the body and limbs with red blotches and welts from a single sting on the shoulder. Specimens of *C. sanguisuga* received in July, 1899, from Mayersville, Miss., were accompanied by the statement, which is appropriate in view of the fact that the newspapers have insisted that the

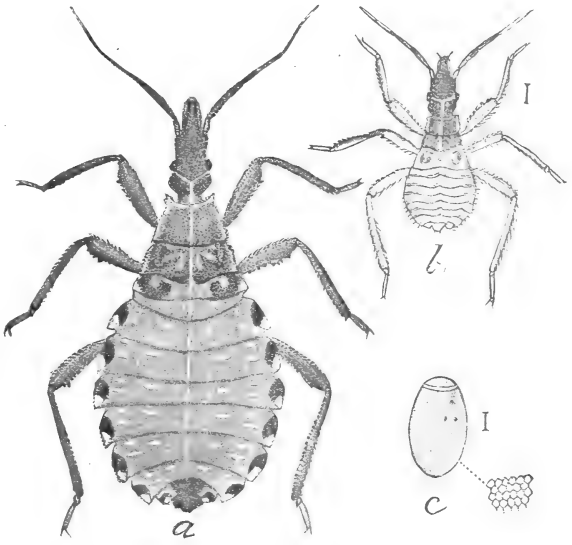

FIG. 23.—*Conorhinus sanguisuga: a*, larva, second stage; *b*, newly hatched larva; *c*, egg with sculpturing of surface shown at side—all enlarged to same scale (from Marlatt).

"kissing bug" prefers the lip, that a friend of the writer was bitten on the lip and that the effect was a burning pain, intense itching, and much swelling, lasting three or four days. The writer of the letter had been bitten upon the leg and arm, and his brother had been bitten upon both feet and legs and on the arm, the symptoms being the same in all cases.

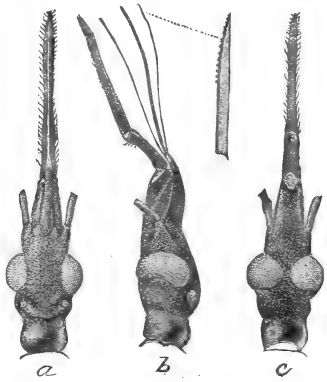

FIG. 24.—*Conorhinus sanguisuga*: *a*, head, showing beak; *b*, same, from the side, with piercing setæ removed from sheath and with tip of one of them enlarged; *c*, same from below—much enlarged (from Marlatt).

More need hardly be said specifically concerning these biting bugs. The writer's conclusions are that the bite of any one of them may be, and frequently has been, mistaken for a spider bite, and that nearly all reported spider-bite cases have had in reality this cause; that the so-called "kissing-bug" scare has been based upon certain undoubted cases of the bite of one or the other of them, but that other bites, including mosquitoes, with hysterical and nervous symptoms produced by the newspaper accounts, have aided in the general alarm. The case of Miss Larson, who died in August, 1898, as the result of a mosquito bite, at Mystic, Conn., is an instance which goes to show that no mysterious new insect need be looked for to explain occasional remarkable cases. One good result of the "kissing-bug" excitement may be in the end to relieve spiders from much unnecessary discredit.

AN INVESTIGATION TO DETERMINE WHETHER MELANOPLUS SPRETUS BREEDS PERMANENTLY IN THE TURTLE MOUNTAINS IN NORTH DAKOTA.

By W. D. HUNTER, *Special Temporary Field Agent.*

ITINERARY.

I left Lincoln August 9 and arrived in St. Paul the next day. Here Dr. Otto Lugger, of the Minnesota Agricultural Experiment Station, who shortly before this time had returned from a trip to Manitoba, gave me most valuable advice and information concerning the country, the people, and the routes, most cheerfully assisting me in every way. The same day I started for Winnipeg, whence the Turtle Mountain region is more easily accessible than from the North Dakota side, and arrived there on the 11th. A call was made upon the chief clerk of the department of agriculture for Manitoba, Mr. Hugh McKellar, who accompanied me to the field the next day. Mr. McKellar, who had already been over the ground in company with Dr. Lugger and Dr. Fletcher, spent three days with me, and, being of an exceedingly energetic disposition and very well known in the province, his assistance removed all the obstacles that harass a newcomer seeking information, and is gratefully acknowledged. We arrived at Boissevain, a village about

9 miles north of the highest point of the Turtle Mountains, on the 12th, and made a preliminary trip into the country. On the 13th we drove about 50 miles along the base of the mountains, visiting as many places as possible in order to gain an idea of the extent of the spread of *spretus;* penetrated quite a distance into the mountains at one place, and reached Deloraine in the evening. On the 14th we thoroughly traversed the territory between Deloraine and the base of the mountains, and on the 15th I started alone to travel across and explore the mountains. One day was spent upon the mountains proper, and the next day I proceeded to Bottineau, in North Dakota. From this point I rode about 30 miles westward, in search of a possible breeding ground for *spretus.* My itinerary then took me along the south side of the mountains, by way of Dunseith, Belcourt, Rolla, and St. Johns. From all of these points, as well as in many cases between them, I made incursions as far into the mountains as the trails would permit. Return was made by way of Wakepa and Boissevain (where the 20th was spent), through Whitewater, to Deloraine. On the 22d Napinka was reached, and the 23d was occupied in an investigation of a sand-hill region on the north side of the Souris River, between that point and the town of Souris. This had frequently been spoken of by the residents as a probable breeding ground for *spretus.* After one stop at Stockton, I proceeded to Winnipeg, and conferred with Mr. McKellar and others regarding the situation, and then took train for Fargo. From this point a side trip to Miles City, in Montana, was taken, in order, if possible, to obtain information regarding the place where a swarm of locusts which had been observed in Manitoba had alighted. Upon returning, a stop was made at Fargo and a day was occupied in conference with the officers of the North Dakota Agricultural College. From this point I returned by the shortest route, through St. Paul and Omaha, to Lincoln, arriving on the 31st.

OBJECT.

For a long time it has been supposed by those who have been interested that the Turtle Mountains, in Manitoba and North Dakota, furnished a permanent breeding ground for the Rocky Mountain locust, and this has taken form among other places in the report of the Canadian Dominion entomologist, Dr. James Fletcher, for 1898, where it is stated: "It is probable that this locust breeds regularly every year in parts of the Turtle Mountains." It has been noticed that invariably the swarms that in recent years have alighted in Minnesota come from the direction of these mountains. In fact the county in Minnesota, namely, Ottertail, that is always invaded whenever this locust reaches that State, and which has figured prominently in the literature of this subject for the last decade, is the nearest agricultural county in the State to the Turtle Mountains, and is, moreover, in exactly the direction from them that swarms of locusts, originating there, would naturally take. During the past two years there has been a visitation of *spretus* in the region directly

north of the mountains, as well as in a similar region directly to the south of them. Under these circumstances it will be seen that it was very natural to suppose that this place was the source of the evil; the evidence most certainly pointed in that direction.

If there were a locality in North Dakota where this dangerous locust was breeding every year there would be continual likelihood that swarms would invade that State as well as Minnesota. Therefore the object of the trip was to ascertain whether the suppositions regarding this region were correct, and in case they were found to be, to devise means of removing the evil.

THE NATURE OF THE COUNTRY.

Turtle Mountain, as this region is called by residents, is a broken plateau of roughly elliptical outline, between 800 and 900 feet above the level of the surrounding plains, and reaching a height of not more than 2,500 feet above sea level. The total area is about 1,500 square miles; the international boundary line passes through in such a manner that two-thirds of this lies within North Dakota, in the counties of Bottineau and Rolette. The surface is covered with a dense and impenetrable growth of scrub oak, poplar, balm of gilead, choke cherry, dwarfed elm, and rose and raspberry bushes, intertwined in the most bewildering manner with vetch. There are no coniferous trees. The vegetation is so dense that there are no roads that penetrate far into the interior, so that the inhabitants, except in the winter, when the snow makes it possible to pass over the top of the tangle to reach the opposite side, pass entirely around it. The whole region is dotted with hundreds of small lakes and ponds, from which the seepage through the light, fertile soil makes an almost tropical growth possible. The only open places are glades, where the grasses and sedges grow up in luxuriant abundance to a height of 4 or 5 feet, and which often form a bed of standing water. From an extended and careful survey of the whole region I am able to state that there are absolutely no open places, even measurably free from vegetation, which could be suitable for the hatching of *spretus*.

From time to time forest fires have swept over the mountains. In 1892 the whole territory was burned over, and the smoke was so great that time that it darkened the sky at Winnipeg, over 200 miles away. But within one season the humus formed, which is too light to be used by locusts for the deposition of eggs, gave rise to a dense growth of hawthorn and Solidago, the second season showing numerous shrubs and small trees covering the ground.

The country is unsettled, except for a colony of French half-breeds near St. Johns and a small summer resort at Fish Lake, in Rolette County. But wherever the farmers have taken up and cleared the "bush," as the English people there call it, the result is seen in yields of wheat, oats, and potatoes that are marvelous. The only trouble is in the often excessive moisture in the soil, from seepage from the lakes.

To gain an idea of the Turtle Mountains, imagine that following well-known laws and owing to its considerable elevation, a portion of the

northern deciduous forest, which normally does not reach south of the Assiniboine River, in an isolated case crops out again. Practically all of that part within Manitoba has been made a forest reserve by the Dominion government. We will thus see that a place that is virtually a transposed portion of the country north of the limit of the prairie region, far beyond the limit of *spretus* and totally unsuited for the continuation of that species, has been suspected, owing to a lack of definite knowledge, of furnishing breeding grounds. It is the one part of the country in which it may be positively stated that *spretus* does not breed.

There is along the escarpment of the Turtle Mountains, extending from about the point where the international line crosses the western limit of the hills along the southern slope to the vicinity of St. Johns, an oftentimes broken and narrow outcropping of a sandy substratum. This area is covered with a very sparse growth of grass and was often referred to by the residents as a probable breeding ground for *spretus*. In fact, I was informed by one observer that he had seen a species, presumably *spretus*, breeding there for years before the cultivated lands had been invaded. After determining definitely that the mountain proper was in no sense the sought-for breeding ground, some attention was devoted to this formation. Although doubtless more or less suited for the deposition of eggs by locusts, it was found to be of very limited extent. There will be found a few square yards upon the brow of a hill, and perhaps no more will be found exposed for several rods. Below this the alluvial soil of the low land along the southern slope becomes well marked, and in the western part below this sandy formation we find extensive fields of gumbo. Both of these are, of course, quite impossible places for the permanent harboring of *spretus*. After a succession of favorable seasons the locust might breed in this narrow strip in numbers to invade the cultivated parts and cause damage. But there were none here this year; the swarms doing damage at this time did not originate there, and I am of the opinion that this place never will furnish any considerable number of locusts.

After I had arrived at the conclusion that it would be necessary to look elsewhere for the origin of the swarms that from time to time have come upon North Dakota and Minnesota than in or about the Turtle Mountains, I received information regarding a swarm flying high on the afternoon of the 17th of August over Whitewater Lake and in an almost due southeasterly direction, far above the mountains, into North Dakota. It was very remarkable that all the *spretus* along the northern slope on the mountains had joined this swarm in motion. Where a week before this species had been seen everywhere between Boissevain and Deloraine, upon my return none were to be found. It had been expected that swarms would pass over that region at about that time, since they have always appeared by the 15th of August in Minnesota. On that day, for the first time in a fortnight, the wind had changed from a southerly direction and blew toward a point south of southeast.

I have been at considerable pains to locate this swarm in order to warn those concerned of its presence. The day that it was observed I made use of the telegraph to notify the authorities in Minnesota and North Dakota of what might be expected. However, it has been impossible at the present time to obtain trace of its whereabouts. Owing to a speedy change of wind at sundown on the day of the flight, I have surmised that it did not extend far into North Dakota, and judge that a point somewhere between New Rockford and Fargo will be the center of some destruction next year. It may be, however, that the Red River Valley in Minnesota was reached.

While hastening to reach a point from which the swarm mentioned might be traced in North Dakota, I continued my efforts while in Manitoba to find the actual breeding ground for *spretus*. It should be mentioned, however, that the season was now far advanced and the swarms had left, so that the search was confronted with many obstacles. For the purpose of working out this point a trip was made to a range of sand-hills and barren coulees on the north side of the Souris River, between Napinka and the village of Souris. This was in exactly the direction that the swarm had taken. I found here a sample of a peculiar formation that appears, as I am informed, at places throughout Manitoba and the territory of Saskatchewan and toward the northern limit of the prairies especially. There is exposed a ridge of red sand which is of such fineness and lightness that it is continually blown about by the wind. During many seasons the most labyrinthine hollows and knolls have been formed. Here and there scrub oak and poplar have obtained a foothold, and a few specimens of *Kuhnistera villosa* Nutt. and *Solidago missouriensis* Nutt. are seen in places where an outcropping of rock makes the soil slightly more firm. But I am convinced that this place, to which all persons familiar with the country with whom I consulted regarding suitable grounds for the habitation of *spretus* referred me, can not be the source of swarms. The loose and drifting soil is totally unsuited to their habits. Moreover I received reliable information regarding flights, both this year and in several preceding years, from the northwest of this point.

As accurately as may be stated from the data in hand, *spretus* originates in the territory lying northeast of Regina, toward the Big Touchwood Mountains and to the south of a line drawn between these points. Here, along the Assiniboine River and its tributaries, is a region covered with sparsely occurring grasses which is adapted for the species. But a personal visit to this place at the proper time of the year is necessary for the solution of the question.

THE PRESENT STATUS OF MELANOPLUS SPRETUS IN NORTH DAKOTA.

The three years preceding (1899), in Manitoba and North Dakota, were unusually dry, and a climax was reached in 1898. June, which is usually the wet month in that part, and the month when the locusts hatch, had brought but little moisture. Accordingly, the

swarms of *spretus* which had entered in the fall of 1897, supposedly then from the Turtle Mountain region, had prospered well. The present year, however, there was an unusually heavy precipitation in June, but this came so late that, although it did not affect the earlier-hatching *spretus*, still most of the late-hatching species were destroyed. It was easily noticed that the ordinary species of the plains were remarkably scarce and, until a colony of *spretus* or the form of *atlanis* which appears there was reached, grasshoppers of all kinds were almost entirely absent. *Melanoplus spretus*, *M. bivittatus*, and *M. packardi* were the only destructive species present in numbers sufficient to attract attention.

In North Dakota, as was predicted last year, *spretus* occurred most notably at New Rockford, where, approximately, the same area that suffered then was affected. There is in force in North Dakota an excellent locust law. It provides that upon notification by the county commissioners any farmer upon whose place grasshoppers have deposited eggs shall plow all summer-fallow and open stubble fields within a certain time. If this is not done the plowing takes place at the expense of the county and the charges are assessed against the property as taxes. Working under this provision most of the young locusts in the vicinity of New Rockford were plowed under, as many as twenty-seven gang plows working together, and working on Sunday when the need was urgent. It may be confidently stated that the trouble at that place is almost passed.

Along the southeastern slopes of the Turtle Mountains, however, there is a fresh invasion of considerably smaller extent but which, considering the territory affected, is rather serious. At several points between Dunseith and Rolla some little damage was done by *spretus*, and at one point about 2 miles to the east of the last named place the situation was indeed critical. In June a formidable number of locusts appeared from eggs deposited in the fall by parents that had passed the year in that same place. Several acres of wheat were destroyed; and in general this swarm, which to all intents was simply a part of the swarm that was divided in alighting by the Turtle Mountains in 1897, was more destructive than in Manitoba. The total area affected might be included in a quadrangle 10 miles long and 5 wide between Dunseith and Rolla; but within this area only isolated fields, often at considerable distance from one another, were infested. The most damaged field was one of about 10 acres, in which the locusts had begun to feed only after the heads were quite well formed. These were quite dry and consequently the insects fed upon the green part of the stalk just below, causing the heads to fall to the ground and the field was ruined.

Invariably, when looking for locusts in that region, I would ask to be shown where last year there was a field left in summer-fallow, and very uniformly in that immediate vicinity the insects in greatest numbers would be found. By plowing or thoroughly cross-harrowing these and the stubble fields in September, there is no reason why the pests,

even if they should recur for years, as they are not likely to do, could not be entirely overcome. The county commissioners of the two counties affected were consulted. They understand the situation, and with the aid of the admirable law on the subject, it is supposed that systematic warfare will be waged this fall and the locusts exterminated.

THE NATIVE SPECIES.

Associated with *spretus* in this region there was an unusually large number of *M. atlanis* (principally the large, very dark-colored form mentioned by Scudder in his Melanopli, p. 183, from the Northwest Territories) which the preceding dry seasons had caused to flourish. In many places this form, which seems certainly worthy of nominal recognition, has caused as much damage as *spretus* in others. *M. bivittatus* was seen everywhere in a most flourishing condition, and was by all odds the most common locust observed. By the 20th of August the females of this species were depositing eggs, often for this purpose boring down in the hard-beaten roadbed, where millions were destroyed by the passing vehicles. The edges of grain fields and land under summer-fallow that was measurably firm from rains or otherwise were generally selected. At one place about 10 miles northwest of Bottineau and near the Dominion line, *M. packardi* was as numerous as the other species were anywhere, and demonstrated that it should be listed among the locusts capable of the greatest destruction. This species prefers the roadsides for the deposition of eggs. As it evinces an inclination to abandon wild grasses and to feed upon cultivated grains it should be watched, for the rather disastrous results that have followed a similar change of food habit by *Dissosteira longipennis* might be repeated. It seems, however, that a peculiar succession of favorable seasons has brought about results that may not become fixed nor in any way normal, and that may not occur again for many years.

In general it may be stated that the parasites have not been sufficiently numerous in the Turtle Mountain region to affect the situation at all. *Trombidium locustarum* was often seen and was generally distributed. As a test, near Dunseith I captured 25 individuals of *spretus*, and of these 18 had mites upon them. But in a slightly removed locality only 2 or 3 out of the same number were found parasitized. Some parasitic Diptera were seen, but the number was not large. All in all, the locusts were remarkably healthy.

SUMMARY.

I. *Melanoplus spretus* does not breed permanently in the Turtle Mountains nor in that immediate vicinity. The ground is totally unsuited to the purpose, and, moreover, swarms descending upon North Dakota and Minnesota have been traced from far to the northwest of that place. The probable permanent breeding ground is upon the Assiniboine River, north and east of Regina in the Territory of Assiniboia.

II. There has been a visitation of *Melanoplus spretus* in North Dakota, besides at New Rockford, near Rolla. The county authorities will probably take the matter in hand and reduce the danger to a minimum.

III. The native species (*Melanoplus bivittatus, M. atlanis* and *M. packardi*) have attracted attention on account of dry years. *M. atlanis* has been destructive in restricted areas all through the Red River Valley.

IV. An outbreak of *spretus* similar to that which took place at Rolla will probably occur next season at some point between Devils Lake and Fargo. This swarm, however, may have reached Minnesota.

THE BRONZE APPLE-TREE WEEVIL.

(*Magdalis œnescens* Lec.)

By F. H. CHITTENDEN.

REPORTED INJURY IN WASHINGTON STATE.

January 14, 1899, Mr. S. Kerr, of Sunnydale, Wash., wrote this Division that in the fall of the previous year his attention had been called to a discoloration which appeared in spots upon apple trees in his vicinity. In removing a piece of bark a small hole was disclosed, and on following this up a specimen of a borer was found. Thirty-eight such larvæ were taken from a single two-year-old tree at that time and several hundred were obtained in that orchard. On further inquiry it was ascertained that most of the orchards in the vicinity were affected similarly, and the owners were quite anxious to learn of some easier way to rid themselves of the pest than by cutting them out. Mr. Kerr's own trees, he wrote, were entirely free from attack, a condition which he attributed chiefly to an annual wash of the trunk and larger limbs with lye. One of the difficulties in combating insect pests of this sort in that locality consists in the fact that about one-half of the territory is planted in orchards, while the remaining half is covered with timber and brush, the wild deciduous trees offering the best sort of shelter for pests which attack also orchard trees.

February 28 we received infested twigs from which we later succeeded in rearing the beetle, which is now identified as *Magdalis œnescens* Lec. On the last-mentioned date our correspondent wrote that the tunnels of this species, which are illustrated on a subsequent page (fig. 26), seem to start in the majority of cases from the butt of a tree and often continue up 5 feet from the ground; that while sometimes larvæ are found in the trunk most of them are in the larger limbs. Larvæ are sometimes found singly, and often from two to six occur together. The trees that have thus far been found to be most subject to attack are Baldwin and Ben Davis. King of Tompkins, Northern Spy, and Bellflower occurring in the same orchard appeared to be free from infestation.

In a letter dated March 3 our correspondent stated that a dead tree which had recently been cut down was so full of borers that whenever the wood was cut into borers would be disclosed. In the samples which he sent at that time this was found to be the case. Every portion of the twigs showed the borers or their galleries.

In a letter dated March 24 our correspondent wrote that he had since visited several other orchards and was very much surprised to see the extent of the damage done by this little pest. "There is hardly an orchard in this vicinity," he wrote, "but has been injured more or less by it. Two-year-old to 20-year-old trees appear to have been attacked indiscriminately, and in many cases ruined. If anything, the borers seem to have a preference for the north side of the trunk, but on the limbs they occurr everywhere. It puzzles me somewhat that, though I can hardly ever find any borers in the trunks and very seldom even see galleries there, I invariably see the dark maroon blotches and dead bark under these discolorations." There seemed to be a rather general impression which appears to have been proven to be a true one) that the diseased condition of the trees was due to "canker" or "black spot."

In the last specimens received there were numerous parasitic insects present in the galleries, at least two of the parasites to one of the borers. Specimens of wood kept in the insectary of this Department disclosed the beetles during March, but other specimens received later did not develop during that month.

Writing April 17, Mr. Kerr stated that the local fruit inspector, a Mr. Brown, had informed him that he had noticed the ravages of this insect eight years before the present time, but had not regarded it as a dangerous species, being much surprised to learn the extent of recent injuries. Mr. Kerr's observations pointed to the borer as commencing near the base of very young trees, but as soon as these grew larger, ascending into the limbs, evidently preferring young and tender wood.

ATTACK BELIEVED TO BE SECONDARY TO THAT OF A FUNGUS.

April 27, 1899, Prof. C. V. Piper, Pullman, Wash., sent a specimen beetle of this species, from Tracyton, Kitsap County, with the information that the insect was reported to be doing serious damage to the apple industry in that State, many complaints relative to it having been received during the year.

Later, however, on the occasion of a visit to this office in the latter days of September, the same gentleman stated that he had given the subject of the attack of this species in his State considerable attention, and his first suspicions in regard to the injurious character of the insect had been much allayed by the discovery that insect injury was apparently secondary to the fungus disease known as "canker" or "black spot." The presence of this fungus causes large, more or less oval blotches, and it is in these that the female selects, evidently by preference, a place for oviposition. Examination of twigs received from Sunnydale shows on these cankerous spots, or, in some cases, at the sides of them, the minute punctures made by the proboscis of the female while depositing her eggs. Oviposition was noticed in the orchard much later than in our rearing jars, continuing well on during the summer season.

OCCURRENCE IN OREGON.

On the occasion of a visit of Dr. A. D. Hopkins to the Northwest, in April, 1899, adults and pupæ were found on the 28th at Corvallis, Oreg., in the bark and outer wood of the branches of dead apple, and Professor A. B. Cordley, of the State Experiment Station located in that town, stated that it was of common occurrence in such locations.

INJURY IN BRITISH COLUMBIA.

There is one record of injury by this insect, by Dr. James Fletcher, published in the Report of the Entomologist and Botanist for 1898 (1899), page 207. He mentions receipt of specimens of apple boughs containing the larvæ of this insect from Victoria and Nanaimo, British Columbia, with report from Mr. R. M. Palmer, of the former locality, that these bark-boring larvæ did much harm, especially in young orchards on dry lands of the island. Many young trees were described as being killed outright or so badly injured that they would scarcely recover where preventive measures were neglected. Attack was also mentioned, on the authority of the Rev. G. W. Taylor, on Gabriola Island, by the beetles feeding upon the leaves of cherry. This was noticed during two seasons, and hence may be considered a regular habit of the beetles. Dr. Fletcher's name of bronze apple-tree weevil is adopted.

DESCRIPTION OF THE SPECIES.

The adult of this borer may be recognized by the accompanying illustration (fig. 25*a*). It is rather remarkable in the structure of the prothorax, the posterior angles of which are prominent and produced over the base of the elytra, a character which it shares with other species of the genus. The beak is of about the same length as the prothorax and the femora are acutely dentate. The color alone, black bronzed, will distinguish the species from others of the genus.

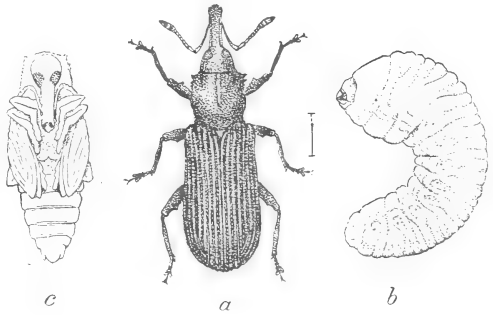

FIG. 25.—*Magdalis cænescens: a*, adult weevil dotted portion of size line showing length of snout; *b*, larva; *c*, pupa—six times natural size (original.)

LeConte's description appeared in 1876 and was based upon material from Oregon (Proc. Am. Phil. Soc., Vol. XV, p. 192). It is quoted herewith:

Elongate, black bronzed, slightly pubescent; head, beak and prothorax densely finely punctured, the last longer than wide, rounded on the sides, which are serrate in front; hind angles small, prominent, base bisinuate, disk subcarinate in front of the middle. Elytra obliquely impressed behind the base, and also behind the middle; striæ composed of not very large punctures, interspaces finely rugose. Mesosternum not protuberant; thighs acutely toothed, claws distinctly toothed near the base.

The length exclusive of the beak varies from a little less to a full sixth of an inch (3 to 4^{mm}); the width is less than half the length.

The species is limited in its distribution to the Pacific Coast, and it apparently occurs throughout the States of Oregon and Washington, where, according to Professor Piper, it is very abundant west of the Cascade Mountains. The full list of known localities include: Sunnydale, Puyallup, Tracyton, Vancouver, Sedro, and Woolley, Wash.; Salem, Hood River, and Corvallis, Oreg.; Victoria, Nanaimo, and Gabriola Islands, British Columbia.

LIFE HISTORY.

From the excellent lot of material received from Mr. Kerr a fair idea of the insect's life stages may be had.

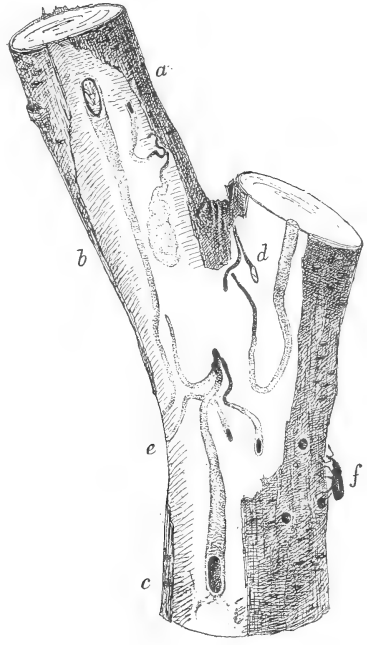

FIG. 26.—Work of *Magdalis œnescens*: *a*, pupa in its cell; *b*, exterior of pupal cell; *c*, empty cell; *d*, parasitic pupa in its cell; *e*, two empty cells of parasite; *f*, beetle and holes made by beetles in their escape—all natural size (original).

The larva, illustrated at *b* of figure 25, departs from the usual curculionid type in being rather larger in the prothoracic portion, in which respect it suggests the Bostrychinæ. It is, however, legless and less hairy than in that group. It is perfectly white in color and the surface of the body is rather strongly wrinkled. The mouth-parts are small and dark brown at their sutures and tips only, the remainder of the head being nearly the same color as the body. The length in curved position as figured is 4^{mm} and the greatest width nearly 2^{mm}.

The pupa, figured at *c*, shows much of the appearance of the future beetle. The head and snout are bent down upon the abdomen between the legs and the tips of the thorax or humeri show the serrated points seen in the beetle. It is of the same white color as the larva and its length is a little less than that of the beetle.

A wild food plant of this weevil was observed by Mr. Schwarz on the occasion of a visit to Oregon in May, 1892. It is a species of thorn, presumably a Cratægus, upon which the beetles were found in the vicinity of Hood River.

Judging from the condition of the insect at the time of the receipt of sendings it makes its first appearance in a latitude like that of Sunnydale in the early part of April and continues, according to Professor Piper, till at least the middle of August.

Soon after the appearance of the insects in April they copulate and lay eggs for the next generation, as previously described.

The tunnels made by the larvæ after hatching may branch off in any direction up or down a limb or at right angles to its main axis. They are not always so easily traceable as in the piece of apple twig illustrated, being sometimes very irregular in shape, running in all directions, crossing and recrossing in hopeless confusion. The average length of the burrows is a matter of only 1 or 2 inches, the largest seen measuring only $2\frac{1}{2}$ inches (47mm). At their beginning they measure about half a millimeter in width, and at their end where the pupal cell is formed $1\frac{1}{2}$mm to a little more than 2mm. The length of the pupal cells is 5 or 6mm. They are rather regular oblong oval in shape (see fig. 26, *a* and *c*.)

The larva completes its growth toward the end of the warm season and with little doubt hibernates in this stage, undergoing transformation to pupa and thence to imago in March and April respectively. The beetle makes its escape through a round hole which it cuts out through the bark by means of the mandibles at the end of its rostrum or proboscis. The diameter of these holes is from 1 to a little more than 1mm. These holes are figured natural size (fig. 26, *f*).

The native species of true weevils (Rhynchophora exclusive of Scolytidæ) produce as a rule a single generation annually, and the present species is probably no exception.

Professor Piper has kindly furnished for publication in this connection his notes bearing upon the biology of the species, which supplement our own and render the account more complete. These notes include a brief description of the egg, an account of oviposition, the supposed correlation of fungous disease and insect attack, feeding habits of the beetles, and observations which show quite conclusively that the species is single brooded:

BIOLOGIC NOTES, BY C. V. PIPER.

The egg.—Length, $\frac{1}{2}$mm; width, $\frac{1}{4}$mm; ovoid, yellowish-white, smooth, shining.

Ovipositing habits.—The eggs are laid singly in horizontal holes burrowed in the bark to the depth of about 1mm. Usually from 12 to 25 of these holes are made in a more or less circular area 6–10mm in diameter; but, in some cases at any rate, eggs are not laid in all of them. The beetle usually requires half an hour or longer to burrow each hole and two minutes in which to deposit the egg. In one case which was watched the beetle burrowed first for twenty minutes, then turning around as if on a pivot she tested the hole with her ovipositor. Apparently it proved too shallow and she turned sharply about and burrowed for twenty-one minutes longer. At the end of this time she turned about as before and immediately deposited an egg at the mouth of the hole. Again turning she pushed the egg in with her beak, and then flew away.

In another instance the beetle burrowed for thirty minutes and then laid her egg in the burrow exactly in the same manner as above described.

Apparently the different egg cavities in each group are burrowed at different times; at least in all the cases observed the beetle went away after digging one cavity and laying her egg therein.

Mr. D. A. Brodie reports that he several times saw the beetles burrow holes and fly away without depositing eggs therein. These observations, taken in connection with

the fact that commonly only one beetle emerges from each cluster of egg cavities, as proven by the single exit hole, indicates either that a large proportion of the eggs or larvæ are destroyed or else that but few eggs are laid. Probably both explanations are true in part.

In nearly all cases these egg cavities are burrowed in or immediately adjoining bark attacked by the "black spot" or canker, a fungous disease caused by *Macrophoma mali* Peck. In only a few instances did we observe egg burrows in healthy bark, and in these cases the trees were much weakened by the attacks of the fungus. We were quite unable after a careful search to find any trees unaffected by the canker that were attacked by the weevil, and there can be no doubt that the damage caused by the weevil is very insignificant compared to that caused by the fungus. As the tissue invaded by the fungus always dies within a year, it follows that the weevil does no damage in such spots; and as it attacks healthy bark so seldom it certainly does but little injury. It is possible, however, that if the canker is held in check the beetles may attack healthy bark more frequently.

Feeding habits of the adult.—Our earliest record of the appearance of the adult is April 15. From this time on, as late at least as the middle of August, the beetles are abundant. Shortly after their first appearance they may be found laying eggs, and as new adults are constantly emerging, this goes on through the whole season. The adults are found only occasionally on the trunks of the trees, usually where they are ovipositing or have just emerged. On the leaves of the trees, however, they are abundant, and are frequently found *in coitu*. They feed only on the pulp of the leaf, biting out shallow holes usually to the lower epidermis of the leaf but sometimes quite through. Where very abundant many of the leaves come to be quite riddled from their attacks, though ordinarily this injury is of slight consequence. The beetles are not very quick nor easily alarmed, so that their actions may be watched indefinitely, even with the use of a lens.

The species evidently single brooded.—From the egg to the adult occupies apparently one year. This would seem clearly to be the case from the relations of the insect and the canker disease. The canker spots begin in the fall and reach their limit of growth, which is sharply marked, either before or early in the next spring. In this diseased tissue the eggs of the weevil are laid during the summer. By the following summer the cankered bark is dead and nearly dry, and covered with the black spore containing pustules. It is always from bark of this kind that the adult beetles emerge. We have never found them in older dead and diseased bark, which indeed separates from the wood at this time, and only rarely does the larva burrow beyond the limits of the diseased tissue. It necessarily follows that the larval and pupal stages do not occupy more than one year, and from the same facts they can require little less time than that period.

FURTHER INVESTIGATION DESIRABLE.

The desirability of additional observations and investigations becomes obvious to anyone who has perused the preceding paragraphs. It seems not impossible, in the absence of positive proof to the contrary, that certain canker-like spots or blotches on apple trees may in reality be caused primarily by the attack of the borer and that parasitic fungous attack is secondary. Professor Piper, however, writes that canker spots are common without the presence of larvæ and that young canker spots seldom show any egg punctures.

It is also possible, and even probable, that more than one fungus is present in limbs affected by the weevil, and further study will be necessary to establish the economic status of all the factors that contribute to the premature demise of the trees in the affected region.

A point that lends color to the hypothesis that the beetle is capable of being a primary enemy is that congeneric species are known to attack healthy trees, and hitherto, so far as the writer can learn, no fungous disease has ever been associated with any of them, the same being true of other species of beetles related zoologically or of similar habits. The beetles were found to continue living in dead and dry limbs nearly or quite a year old, and the presence of a fungous disease could not be detected in them when examined in the Division of Vegetable Physiology and Pathology. There were also on the limbs examined numerous holes from which the insects had issued and where the fungus had not been present. The cankerous spots were almost invariably attacked by the weevils, and we have the testimony of Professor Piper that the "black spot"[1] was actually detected in these places.

It is hoped that another season may see these points made clear.

PARASITIC ENEMIES.

From the material in which the parasites were first detected thirty specimens of Chalcidids and one beetle were reared during the week ended April 12. Of this lot 17 were true parasites and 13 were hyperparasitic. The primary parasite of this lot was identified by Mr. Ashmead as an undescribed species of Dinotus, and of a subsequent rearing as *Chiropachys colon* Linn., a well-known parasite and efficient destroyer of the fruit-tree bark-beetle (*Scolytus rugulosus*). The secondary parasite is *Asecodes albitarsis* Ashm.

METHODS OF CONTROL.

This apple-tree borer may prove a difficult insect to successfully combat unless future observation should show that its attack is mainly secondary to and dependent upon that of the fungus. In case it is shown that the insect is not dependent upon the fungus and that it attacks vigorous, healthy growth, insecticides and other direct remedies will be necessary.

From the general manner of the insect's work, it should prove amenable to the same treatment as that outlined for the fruit-tree bark-beetle in Circular No. 29 (2d ser., pp. 7, 8) of this Division. Clean culture would, of course, be the first requisite. The use of mechanical barriers and deterrent washes, employment of girdled trap-trees, and the use of kerosene emulsion or creosote oil as insecticides are among the remedies advised against the bark-beetle.

It will be noticed that Mr. Kerr ascribed the immunity of his trees from attack to an annual wash of lye applied to the trunks and limbs. Mr. Palmer states that a wash, composed of lime, soap, and carbolic acid is effective if applied early in spring (in British Columbia) and renewed at the end of May.

[1] As this bulletin is going to press Professor Piper writes that the fungus in question is *Macrophoma currispora*, recently described by Dr. C. H. Peck, from British Columbia (Bul. Torrey Bot. Club, Jan., 1900, p. 21).

There can be no doubt that the beetles could readily be reached by spraying the leaves, since observation has shown that they feed on the foliage of their host plants.

Should it be proven that the fungus is the primary cause of injury, as is now apparently the case, all efforts should be directed toward the suppression of this fungus; but, as the subject of fungous diseases and their remedies does not come within the scope of this Division, it need not be discussed here. It may be said, in any case, that when a tree becomes badly infested by the insect it should be cut down and destroyed by burning, and this should be done before the month of April to prevent the development of the insect and its issuance from the wood for the infestation of other trees.

TWO NEW CECIDOMYIANS DESTRUCTIVE TO BUDS OF ROSES.

By D. W. Coquillett.

At intervals during the past twelve years complaints have reached this office in regard to certain kinds of insects which infest the buds of roses grown under glass, causing them finally to wither and turn black. The blossom buds as well as those for the production of wood and foliage are thus attacked, and in several instances during an entire season not a single flower of certain varieties was produced in some of the rose houses owing to the depredations of these pests. For some curious reason the only varieties of roses known to be subject to these attacks are the Meteor, Wooton, La France, and a sport of the latter known as the Duchess of Albany. No other variety of rose has been known to be attacked, although frequently grown in the same house side by side with plants of the kinds mentioned which had in some cases lost all of their buds.

The pests in question are small legless larvae which are to be found within the buds at the bases of the outer scales, or sepals, if a blossom bud is examined. These larvae are of a white color when young, but become orange red in the latter part of their larval periods. Their manner of transformation is at present not known to the writer, but it is probable that they enter the earth and pass through their various changes in a cell or cavity formed just beneath the surface. So far as I am aware, they have never been known to attack roses grown in the open air, and this would seem to indicate that they were originally natives of some tropical region, from which they have been imported into this country either upon plants, cuttings, or in the soil in which the plants were imported.

The earliest record of the occurrence of these pests in this country that has come to my notice is a letter dated September 29, 1886, accompanied by specimens, addressed to this Department by Mr. Ernst Asmus, of West Hoboken, N. J. This letter has already been published on page 284 of Insect Life for March, 1889, and is followed by a

second letter under date of January 18, 1889, in which Mr. Asmus records the discovery of this pest in two other florists' establishments in his neighborhood.

In the same periodical for March, 1891 (p. 294), is a letter from Mr. Benjamin Hammond, Fishkill, N. Y., under date of October 25, 1890, relating to the same or a similar pest which has destroyed many buds of the Wooton rose grown under glass in his locality.

More recently Mr. P. H. Dorsett, of this Department, has published a short notice of an insect having the same habits, recording his observations of its attacks on the Meteor and La France roses grown under glass in the vicinity of Washington, D. C.

These are the only published references to Cecidomyian larvæ attacking buds of roses in this country that have come under my notice, but the note-books of this Division indicate that they have been received from several localities besides those recorded above.

June 2, 1891, Mr. A. B. Cordley, at that time in the employ of this Division, detected larvæ of this kind in the buds of rose bushes in a florist's establishment in this city; they were under the sepals and usually occurred singly, but sometimes in clusters of five or six individuals. More of these larvæ were obtained by him on the 5th of the following September, and from these the adult flies were bred on the 15th of the same month.

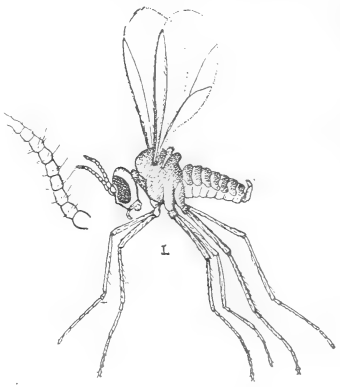

FIG. 27.—*Neocerata rhodophaga:* adult much enlarged, antenna more enlarged at left (original).

April 30, 1894, larvæ were received from Mr. W. J. Stewart, Boston, Mass.

On October 22 of the same year Mr. Theodore Pergande, of this Division, investigated an outbreak of insects of this kind in one of the rose houses in the vicinity of Washington, D. C., and reported that they were first noticed by the owner three years previously, since which time they had steadily increased in numbers. They confined their attacks to the La France, Meteor, and Wooton roses, notwithstanding the fact that other varieties were growing among them. The pests were the most abundant during the latter half of the year, but became quite scarce during the winter season.

October 15, 1897, larvæ were received from Mr. Walter C. Wyman, Chicago, Ill., who stated in an accompanying letter that they infested the buds of the La France and Meteor roses in a rose house in that city, and that other varieties of roses were untouched. He was familiar with the operation of this pest for the previous six years.

In response to inquiry, Mr. L. E. Wood, Fishkill, N. Y., wrote that this species, which was reported, as already stated, by Mr. Benjamin

Hammond as injurious at Fishkill in 1890, had again made its appearance in the summer of 1898, this being the first time it had been noticed since the appearance above recorded.

In the autumn of 1896 Mr. Dorsett collected a number of infested branches of roses from the same rose house as that in which Mr. Cordley had found this insect, and placed them in a jar of water under a bellglass for the purpose of breeding the adult flies, 12 of which were found beneath the bellglass November 4 of the same year. These were placed in alcohol and recently presented to this Division. A comparison of these specimens with those reared by Mr. Cordley reveals the fact that two different species, even belonging to different genera, are concerned in this destructive work. The single male and female specimens bred by Mr. Cordley belong to the genus Diplosis, and judging from the description and figure of Rübsaamen, are closely related to his *Diplosis rosiperda* which in Germany has similar habits (Verhandlungen der Kais.-Kön. zool.-botan. Gesell. Wien, 1892, p. 54, Pl. II, figs. 7 and 8). The larvæ of the two species, however, are very distinct; ours entirely lacks the so-called "breastbone"; the posterior end of the body is rounded and bears several short tubercles, but there is no trace of a pair of very long ones at the extreme apex of the body, nor of a pair of very long bristles anterior to them; moreover, the surface of the body in our larva is comparatively smooth, even under a very high power, not showing a vestige of the minute tubercles wherewith the body of the allied species is densely covered. In order that our species may be recognized in the future, a description of it is given herewith:

Diplosis rosivora new species.

Female.—Antennæ three-fourths as long as the head and body taken together, subcylindrical, fifteen jointed (2+13), first two joints slightly broader than the others, the first slightly longer than wide, the second as wide as long, the third about six times as long as its greatest width, noticeably longer than any of the others, tapering at the base, the apex suddenly narrowed into a petiole one-fifth as long as the remainder of the joint; other joints suddenly narrowed at the apex into a petiole, the thickened portion expanding slightly at its apex, bearing near its base a whorl of bristly hairs, its apical half sparsely covered with similar hairs; some of the hairs in the basal whorl are slightly longer than the entire joint from which they spring; last joint almost one-half as long as the thickened portion of the preceding joint. Wings hyaline, rather densely covered with hairs, first vein reaching the costa slightly before the middle of the latter; third vein terminates slightly below the extreme wing-tip, the basal portion connecting it with the first vein quite indistinct; fifth vein branching slightly beyond the middle of the wing, the upper branch very indistinct toward its apex. Colors (in balsam), head black, antennæ brown, palpi yellow, thorax dark brown, two subdorsal vittæ, the metathorax and front part of the breast yellow, scutellum and abdomen orange yellow, halteres yellow, an orange yellow spot on each knob, legs yellow. Length 1.75^{mm}.

Male.—Both antennæ in the only specimen are broken off toward their apices, but were evidently almost twice as long as the head and body taken together, apparently fifteen-jointed (2+13); first joint slightly longer than wide, the second as wide as long, each of the remaining joints suddenly contracted into a petiole before the middle and again at the apex of each, the narrowed portions longer than the thickened part at their bases, the latter at the base of each joint bears a whorl of bristly hairs, that near the middle of each joint bears two whorls, one with few hairs at its base, the other with many more hairs at its apex; the last joint is nearly twice as long as those near the middle of the antenna, and the second thickened portion is greatly constricted at the middle, four times as long as the thickening at the base of the joint, terminating in a slender process which is almost one-half as long as the thickened portion. The fifth vein at the point where it forks is nearer to the hind margin of the wing than it is to the third vein, and the latter opposite this point is much nearer to the costa than to the fifth vein. Third tarsal joint slightly longer than the fourth and fifth taken together. Colors as in the female. Length 1.5mm.

The specimens bred by Mr. Dorsett belong to a new genus, differing from all others by the much smaller numbers of antennal joints, and both the genus and species are characterized herewith.

Neocerata rhodophaga new genus and species.

Antennæ in both sexes slightly shorter than the head and thorax taken together, nine-jointed; joint 1 obconical, 2 globular, wider than any of the others; joints 3 to 8 only slightly longer than wide, subsessile, the hairs very sparse, not arranged in whorls; joint 9 almost twice as long as 8, slightly constricted near the middle. Wings hyaline, bare except along the hind margin near the base and on the veins, which are sparsely bristly, rather densely bristly along the first half of the costa, interspersed with flattened bristles: the first vein lies very close to the costa, which it joins slightly before the middle of the wing; third vein evenly arcuate, joining the costa far before the extreme apex of the wing, this distance almost equaling one-half of the greatest width of the wing, the extreme base of this vein, where it joins the first vein, very indistinct; fifth vein indistinct toward its apex, forked at its last fourth, the anterior fork reaching the hind margin a short distance basally of the tip of the third vein. First tarsal joint less than one-half as long as the second, claws of tarsi simple. Color of alcoholic specimens yellow, the head and thorax tinged with brown. Length, 1 to 1.25mm.

Nine males and three females, bred November 4, 1896, by Mr. P. H. Dorsett.

This fly is shown in fig. 27 highly magnified, the antenna still more enlarged at the left. The hair lines below show the actual size of the fly.

The larva of this species is at present unknown to the writer.

Some of the rose growers whom I have visited inform me that they exterminated these pests in their rose houses by a continued and liberal use of Persian insect powder, and Mr. L. E. Wood writes that he has complete success in the use of California buhach, a very similar product, which has been recommended by this Division against this pest for years past. One grower assures me that he accomplished the same thing by a liberal use of refuse tobacco stems obtained from a cigar factory. These stems were placed beneath the benches on which the infested roses were growing, and some were also placed on the heating pipes. The stems were quite moist when obtained, and the heat of the rose house caused a constant evaporation, which was sufficiently deadly in its effects upon these fragile insects as to result in their death, without at the same time producing a perceptible injury to the rose bushes. The same grower also informed me that when these pests first made their appearance in one of his rose houses he had all of the rose bushes in that house cut off close to the ground, only to find that when these bushes began to grow the pests were soon apparently as abundant as before.

A NEW VIOLET PEST.

(*Diplosis violicola* n. sp.)

By D. W. Coquillett.

In Europe, two different species of Cecidomyia attack cultivated and wild violets—the one, *Cecidomyia violæ* of Franz Löw, dwarfing the entire plant and causing it to assume the form of a rosette through the working of the larvæ at the bases of the short sessile leaves; the second species, the *Cecidomyia affinis* of Kieffer, folds and distorts the young leaves and unopened blossoms. It is somewhat curious that, although sweet violets have been somewhat extensively cultivated in this country for many years past, yet up to the year 1896 no complaint had been made of any Cecidomyian attacking either these or any of the many wild species of violets which occur in almost every locality in this country.

On October 5 of the above mentioned year Mr. P. H. Dorsett, of this Department, brought to this office several leaves of sweet violets from the vicinity of Washington, D. C., each of which was folded up in such a manner as to bring the upper surfaces together; the leaves were much wrinkled and distorted, and each contained from one to three whitish, or more or less yellow, legless larvæ. Thirty-one adults were bred from these on the 23rd and 24th of the same month. Mr. Dorsett has published a brief account of this pest, which is known among florists as the "gall fly", together with figures of the distorted leaves. More recently Dr. Howard, by request of a correspondent, has published a brief account of this insect in a current publication.

Plants of violets infested with what is evidently this same pest were received July 17, 1896, from Mr. W. A. Hammond, of Richmond,

Va., with the statement that these insects had been quite destructive to his violets during the months of June and July for two years past. The attack was principally directed against the youngest leaves, which in a short time turned brown and dropped from the plant. As many as a dozen larvæ were sometimes found within a single folded leaf.

September 9 and 21, 1897, larvæ of this species were also received at this office from Mr. W. Davison, of Nyack, N. Y.; and on August 31, 1898, others were received from Mrs. J. H. Marbacher, Tappan, N. Y. The latter stated in an accompanying letter that her violet plants were literally covered with these larvæ in the folded and distorted leaves. From those received, 3 adults issued on the 9th of the following month.

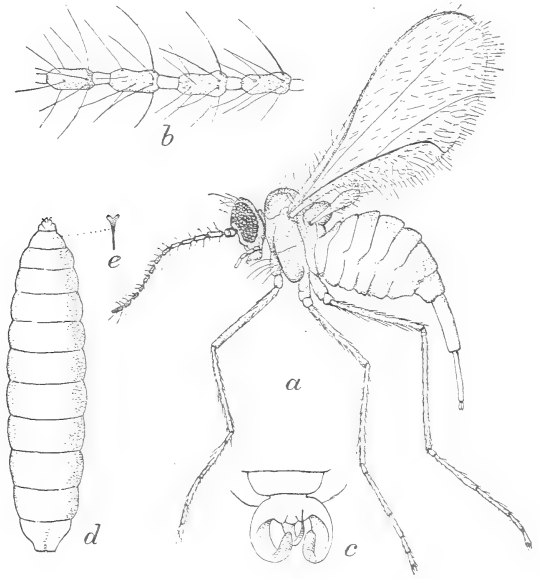

FIG. 28.—*Diplosis violicola*: *a*, female fly; *b*, female antennal joints; *c*, male genitalia; *d*, larva; *e*, breastbone of larva—*a*, *b*, much enlarged; *c*, *d*, *e*, more enlarged (original).

Under date of October 12, 1898, Mrs. J. Sampson, Gordonsville, Va., wrote that a "gall fly," presumably this species, had been injurious to violets grown in beds during the early spring of that year, but all the infested leaves had been picked off and destroyed and no specimens were available at the date of writing.

Writing under date of January 27, 1899, Mr. W. V. V. Powers, Cornwall-on-Hudson, N. Y., stated that he had noticed this species about three years previously, and had been troubled with it more or less ever since. He was not certain that there was any connection between the appearance of this pest and the introduction of the so-called California violet, but stated that they both appeared the same year in his vicinity.

In a letter published December 3, 1898, Mr. Davison, mentioned above as having sent specimens of this insect to us for identification, states that his experience with this maggot convinces him that it is the worst enemy the violet grower has to contend with, owing to the extreme difficulty experienced in its destruction without injury to the plant. He says:

> It secretes itself in the crown of the plant; the leaves as they come up are tightly curled, and when unfolded there will be found 6 to 8 small white maggots. On some plants you can pick off the young leaves until the crown is bare. Loosing the crown will cause the side crowns and runners to start; the latter must be taken off. The maggot seldom appears on the side crowns, giving them a chance to make good plants. The flowers will not be as large as crown flowers.
>
> I find when the maggot leaves the plant it goes into the ground. As proof of this, I placed 40 or 50 of the leaves containing maggots on a pot filled with soil, covering the soil with glass, expecting in this way to see the maggot in the chrysalis state. At the end of two weeks, wanting to send some specimens to the Division of Entomology at Washington, I removed the glass, but the maggots were gone. I turned the soil out of the pot and found maggots all through the soil in the same state in which they left the leaves.

He also expressed the belief that the fly was introduced with manure purchased from a person who collected garbage, as no flies were seen in his greenhouse previous to the introduction of this manure, and the maggots were observed only where it was used. Further experience is necessary to confirm this opinion.

The subject of the so-called gall flies which affect violets has also received mention by Mr. B. T. Galloway in his recently published handbook on violet culture under the heading "Gall Fly Maggots." The nature of the injury is there described and remedies suggested. This account also includes a half-tone illustration reproduced from a photograph showing the twisted leaves of violets.

This insect, although belonging to the same family as the two species already referred to as also attacking violets in Europe, pertains to a different genus; and while its work is very similar to that produced by the *Cecidomyia affinis*, yet a comparison of the adult gall-gnats with the description of the last mentioned species reveals the fact that the two are very distinct, not only differing in the venation but also in the structure of the antennæ. Following is a description of our species:

Diplosis violicola new species.

Antennæ in both sexes three-fifths as long as the body, 14-jointed (2×12), the first two joints subequal in length, each as broad as long; third joint more than twice as long as the second and more slender, other joints becoming successively slightly shorter except the last one; joints 3 to 13 each slightly constricted near the middle, narrowed at the apex into a petiole, which, on the thirteenth joint, is almost one-half as long as the thickened portion of the joint; 2 whorls of bristly hairs on each of the joints from 3 to 13 inclusive, one near the base, the other near the apex of the thickened portion. Head and thorax

black, the hairs yellow; antennæ and legs brown, halteres yellowish, scutellum and abdomen bright yellow, the hairs also yellow. Wings gray, strongly iridescent, thickly covered with short hairs; first vein extending rather close to the costa, terminating slightly before the middle of the wing; third vein terminating distinctly below the extreme tip of the wing, its basal portion, connecting with the first vein, imperceptible; fifth vein forked near the middle, the anterior fork terminating midway between the apex of the posterior fork and of the tip of the third vein. Length 1.25 mm to 1.50 mm.

The remedy generally employed against this pest consists in picking off and destroying the infested leaves. It is also amenable to the hydrocyanic-acid gas remedy, as detailed in Circular No. 37, 2d Ser., of this Division, and undoubtedly also to the buhach insect powder, recommended as a specific against the "gall flies" on roses. Tobacco, however, can not be safely used to any great extent on violets grown under glass.

INSECTS AND THE WEATHER: OBSERVATIONS DURING THE SEASON OF 1899.

By F. H. Chittenden.

Every economic entomologist receives from time to time complaints regarding some insect which is stated to be new to the locality of the sender, and, among other questions, it is often asked, will the insect prove injurious and is it likely to reappear in future years? Such communications usually apply to insects which are periodical in their attacks, common examples of which are to be found among the bill-bugs, numerous flea-beetles, cutworms, army worms, etc., and to introduced and other insects which are extending their range. In the case of many species, such as certain forms of plant-lice, the imported cabbage worm, tussock moth, etc., we know from years of experience that parasites or other enemies are almost sure to check the later appearing individuals or later broods of the insect (if there be more than one generation annually), and we can usually predict a scarcity in numbers for one or two years to come, although we know that eventually there will probably be a repetition of the attack.

Very often it happens, when we are unable to account for a sudden appearance or disappearance of an insect on the score of the activity of its natural enemies, parasitic, predaceous, fungous, or bacterial, that we give expression to the opinion that some atmospheric condition, heat or cold, dryness or moisture, is the principal element that has brought about its reported abundance or scarcity, as the case may be; but if asked to show in just what manner the weather has been responsible we sometimes hesitate before offering the desired information.

Official entomologists report injury or scarcity of this or that insect

year by year in their annual reports, seldom giving the cause of rarity or abundance a thought. During the season which has just passed the writer has given some attention to this subject, particularly in its bearing upon insects affecting garden crops; and it is the object of this paper to explain certain of the apparent phenomena of sudden appearances and disappearances, the notes which follow being directed toward showing that certain southern, mostly Austroriparian, forms of insects occurring in and near the District of Columbia have been destroyed or lessened in numbers by recent severely cold weather (as well as by other causes), while certain northern, or Transition, species owe an evident very perceptible increase to the same cause.

As a preliminary it will be necessary to define briefly the location of Washington as regards the life areas.

THE LIFE ZONES ABOUT THE DISTRICT OF COLUMBIA.

Inquiry of those who have collected for years in Maryland and Virginia, within a radius of 100 miles of Washington, brings out the fact that many animals belonging to the Lower Austral, or more strictly Austroriparian, life zone may be found within about 65 miles southward, while a somewhat smaller number of Transition or Alleghanian forms occur within the same distance northward.

At Piney Point, Md., zoologists, members of the Biological Survey of this Department, and others, have found certain birds nesting which are not known to breed farther north in this longitude. Mr. Schwarz, who has done considerable collecting in this vicinity, particularly of Coleoptera, informs me that many southern species occur there which have never been taken farther north, and that many of these have found their way up the Potomac into what is called the Eastern Branch, as far north as Bladensburg, Md. (about 7 miles east and a little north of Washington), that are identified with the Lower Austral life zone and are seldom to be found much farther north.

Northward the exact southern limit of the Transition life zone does not appear to be so well defined. Some Subboreal and many Transition forms of Coleoptera, Mr. Schwarz has observed, are to be found on some of the highest mountains near Harpers Ferry and between that point and Penmar, in Pennsylvania, bordering the Maryland State line.

During the writer's first years in the city of Washington he was impressed with the scarcity of individuals of many of the species which were usually to be found in so much greater numbers farther north, and was at first at a loss to account for the fact. Finally it was surmised that the warmer weather of fall and winter interfered with the proper hibernation of many species, the warm spells which are usually experienced here during the winter inducing the hibernating insects to come forth from their retreats and the subsequent sudden cold snaps, for which this district is noted, being responsible for their decrease, many of the insects being killed or so injured that they were unable to survive the winter.

Washington is situated well within the Carolinian area of the Upper Austral life zone, but collectors who have given the study of the distribution of animals any attention are aware that the insect fauna of the northern portion of the Carolinian and that of the southern portion of the same life area differ to a very considerable extent. Although many species are common to both regions, certain forms will be much more abundant either in the northern or in the southern extremities. In other words, there are present in the southern end many forms which properly belong to the Austroriparian section of the Lower Austral, while the northern portion has a preponderance of Transition or Alleghanian species.

The District of Columbia occupies a place in the Carolinian faunal area about midway between the two extremities. Many of the northern or Alleghanian species are rarely met with in numbers save in exceptionally favorable seasons, like that of 1899, while the southern or Austroriparian forms which inhabit this latitude are usually to be found in all years.

SOUTHERN CHARACTER OF THE INSECT FAUNA OF THE DISTRICT OF COLUMBIA.

In the Heteroptera we find perhaps the most noticeable examples from the southern life zones. A very considerable number of large conspicuous southern species[1] habitually occur here, and their usual normal northern limit is not far north of here in Maryland, except near the coast line, where many species of this, as well as of other orders, go considerably farther north than they do inland, some extending into southern New Jersey and parts of Pennsylvania, and a few following the coast to the shores of Long Island.

A notable feature in connection with the occurrence of the northern species of Coleoptera in this vicinity is that they are mostly vernal, appearing late in March or early in April if the season favors or in just about the same temperature which induces them to issue from their winter quarters a month and more later in their more northern habitat.[2] Injurious species which appear at this time include the white-pine weevil (*Pissodes strobi*), certain other weevils and Scolytids which infest

[1] Among these species may be mentioned: *Leptoglossus corculus, Metapodius terminalis, Archimerus calcarator, Euthoctha galeator, Ectrichodia cruciata, Chariesterus antennator, Stenopoda culiciformis, Narvesus carolinensis, Pnirontis infirma, Pygolampis pectoralis,* and *Largus cinctus,* many of which are usually abundant. Of rarer but conspicuous species occasionally taken here are *Sirthenea carinata* and *Tetyra bipunctata.* The former has been taken only at light; the latter on *Pinus inops* early in spring.

[2] Many Lower Austral forms which have become injurious in this region are on the other hand remarkably late in their occurrence in the field, some of them producing an extra generation here after the native species have gone into hibernation.

conifers, *Orsodachna atra*, *Crepidodera helxines*, and other species which are associated with willow.[1]

The other orders of insects doubtless present equally striking examples of the preponderance of southern forms here, but they have not been very closely studied by the writer, and enough has been said to show that the fauna is in the main southern.

EFFECT OF THE COLD WINTER OF 1898–99.

During the season of 1899 the writer was impressed quite early in the year with the unusual scarcity of certain species which we know are more abundant in the South, and which for the most part have been introduced from warmer districts, and the corresponding abundance of many species which, though not peculiar to the North, are more thoroughly acclimated there, and are usually more abundant and destructive in colder climates. This was particularly noticeable of the species which affect garden crops, a group of insects which has engaged the attention of the writer in recent years.

The cause of this was not far to seek. The blizzard which began February 5 was one of the greatest severity, and the weather was the coldest that has been experienced for more than twenty years.[2]

The winter as a whole was an unusually cold one, with few warm spells, and it was a long time after the blizzard before warm weather was experienced.[3]

These conditions would be conducive to the perfect hibernation of Northern species, but would be destructive to Southern ones. A few of the best observed examples of the effects of the cold winter weather of 1898–99 will be given, beginning with a consideration of Southern forms.[4]

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[1] Among conspicuous southern species of Coleoptera occurring near Washington are: *Helluomorpha bicolor* and *nigripennis*, *Phileurus valgus*, *Hoplia trivialis*, *Canthon cyanellus*, *Macrodactylus angustatus*, *Œme rigida*, *Heterachthes ebenus*, *Curius dentatus*, *Liopus crassulus*, *Sinoxylon texanum*, *Acanthocinus*, *nodosus*, *Tetrops canescens*, *Hypor-hagus punctulatus*, *Zabrotes obliteralis* and *subnitens*, *Bruchus obsoletus* and *Apion segnipes*. Among northern forms which are to be found in the boreal zone are: *Phellopsis obcordata*, *Enchodes sericea*, *Boros unicolor*, *Laricobius erichsoni* and *Phyxelis rigidus*.

[2] From notes made by Mr. Clifton, of this office, in his private diary, and which he has kindly placed at my disposal, I am able to state that heavy snows ensued for the three days following the 4th of February; on the 9th the thermometer sunk to several degrees below zero, continuing below for the next two days; heavy snow fell on the 11th, and the blizzard came on the 12th and 13th, traffic being suspended on the latter day and the day following; on the 16th there was heavy rain and freezing. On the 7th of March a smaller blizzard visited the neighborhood, following a warmer spell.

[3] Very much the same conditions have been present over a wide extent of the country east of the Mississippi Valley, as evidenced by correspondence from both west and south. Certain of the correspondence from southern observers will be quoted. Letters were also received from different portions of Indiana, Illinois, and Michigan in regard to the winter weather conditions and its effects upon insects.

[4] It was not alone, perhaps, the severity of the winter of 1898–99 that brought about these conditions as regards the scarcity or abundance of all the insects under observation, since the previous winter was also colder than normal, and without doubt had its effect on some of these species, although evidently not upon others. The effects of the last cold spell were felt upon plants as well as insects, peach trees particularly suffering, as well as certain exotic ornamental trees which were introduced here several years previously.

SCARCITY OF SOUTHERN FORMS OF INSECT LIFE IN 1899.

Prominent among the Southern species of insects which were noticeable by their scarcity in 1899 was the harlequin cabbage bug, *Murgantia histrionica*, which has come northward from warmer States in recent years. This bug has been the most injurious of all garden pests for several years past in the District of Columbia and near-by points of Maryland and Virginia. The first generation of the bug was found this year only upon wild crucifers and not abundantly on these, and with moderate care on the part of the farmer in destroying the first brood practically no trouble would have been experienced with later generations. Even as it is but trifling damage has been done by this species, although in some small fields some injury has been committed, especially late in the season.

The tobacco flea-beetle, *Epitrix parvula*, which has been quite injurious in the past, and was particularly numerous last year when nearly every leaf of tobacco in many districts was "peppered" with holes, was rare the present season, comparatively speaking, its effects being scarcely perceptible on most plants inspected.

The imbricated snout-beetle, *Epicærus imbricatus*, though several times observed, was rarer than in several years.

The green June beetle, *Allorhina nitida*, though locally not really rare, was much less common than usual, and not nearly so abundant as last year. Col. W. Rives reported it extremely scarce at Rives, Md., as did also Mr. A. T. Goldsborough at Wesley Heights, D. C.

The squash-vine borer, *Melittia satyriniformis*, appeared so late in the season that large crops of cymblings were obtained without difficulty, something that was an impossibility, owing to the numbers of the insect, during the season of 1897 and 1898. Later in the season the species showed its presence, but not in such excessive numbers as in former years.

The two Pyralid borers of cucurbit fruits, the so-called pickle worm, *Margaronia nitidalis*, and melon caterpillar, *M. hyalinata*, were neither of them to be found, though frequent search was made for them. The former was observed in considerable abundance in 1897, doing appreciable injury in this vicinity, but could not be found in 1898. The latter was observed, although rarely, in 1898.

The cabbage Pionea, *Pionea rimosalis*, was not found at all in the neighborhood during the season, although many cabbage patches were visited in the course of investigation of insects affecting cruciferous crops. Southward the species was present in some numbers and did appreciable damage. Specimens received in the fall were parasitized.

The garden webworm, *Loxostege similalis*, was not noticed once the past season, although search was made for it. Specimens, however, were received from Georgia, and moths as well as larvæ were numerous during two years preceding. This is very obviously a Southern species, as it extends its range into South America, from which it has spread northward.

The Northern leaf-footed plant-bug, *Leptoglossus oppositus*, though not a species of great importance, was rarely seen as compared with the previous two years; and the same is true of a species of similar habits and economic status, the horned squash bug, *Anasa armigera*.

Of the effect of the cold winter in the South, Mr. H. M. Simons, Charleston, S. C., wrote in response to our suggestion concerning the effect of the climatic conditions upon the imported cabbage webworm, *Hellula undalis*, that the cold weather had probably caused the decrease of this insect which he had noticed for the season of 1899. He wrote July 22 that the previous winter had been unusually severe, being marked with snaps of intense coldness. It is just such weather as this, in the writer's opinion, that would destroy many individuals of an insect which is not yet thoroughly acclimatized with us, since such sudden changes and severely cold spells are practically never experienced in the Old World regions to which this insect is native. Mr. N. L. Willet reported a similar scarcity at Augusta, Ga., saying that it was a difficult matter to obtain specimens until the last of August, when practically the first evidence of attack became manifest. Both of these gentlemen reported serious injury the previous year.

The larger corn stalk-borer, *Diatræa saccharalis*, was also extremely rare in those localities where it was found abundantly in 1898 and prior to that time. Several fields were visited where individuals had been observed in numbers previously and only a single chrysalis was found after several hours' search.

At the same time that the stalk-borer was being observed a close watch for the corn-ear worm, *Heliothis armiger*, was made. This was comparatively rare upon corn and other crops which it is known to infest.[1] In one locality, however, it was reported troublesome and the later generations did some injury, but sweet corn which it generally injures seriously was very little affected. In Mississippi this species did extensive damage the present year to beans by boring into the pods.

The American locust, *Schistocerca americana*, which is usually sufficiently abundant a few miles south of Washington to attract attention, was not noticed at all in 1899 in any of the frequent visits paid to the localities where it has always abounded in previous years until September 23, when a single individual was seen, a few others being observed later.

ABUNDANT NORTHERN FORMS OF INSECTS IN 1899.

One of the most noticeable of the Northern species which were injurious the present season was the imported cabbage butterfly, *Pieris rapæ*, the first generation of which destroyed many early cabbages. The later individuals of this first generation, it was observed, were very

[1] The fall army worm, *Laphygma frugiperda*, practically replaced the last two mentioned insects, being often found, while in search for them, working on corn in a somewhat similar manner.

extensively parasitized in their larval condition by their two most common parasitic enemies, and to these we may ascribe the comparative immunity from later generations of the pest.

The cabbage curculio, *Ceutorhynchus rapæ*,[1] occurred in myriads early in the season on wild crucifers, but did not attack cabbages at the time when they were planted in gardens. The new generation of beetles attacked cabbage and other crucifers, but these had made such good growth that no trouble was experienced.

The clover-leaf weevil, *Phytonomus punctatus*, was observed in the latter part of August by the writer, as well as by Messrs. Schwarz and Pratt, in greater numbers than ever seen before in this locality.

The common rhubarb curculio, *Lixus concavus*, was similarly abundant early in the season in most fields visited, attacking every plant of rhubarb and dock and puncturing often every stalk and leaf-stalk.

The zebra caterpillar, *Mamestra picta*, though reported to occur considerably farther south than the District of Columbia, had not been observed by the writer here until the present year, when considerable numbers were seen.

The plum moth, *Grapholitha prunivora*, which is somewhat of a pest in Canada and some of our most northern States, was quite abundant the past summer in some orchards, attacking and destroying both plums and apples.

The imported currant worm, *Pteronus ribesii*, was also among the injurious species found the present year; but most noticeable of all was the abundance of insects which affect strawberry, blackberry, and similar rosaceous crops. Among these were the oblique-banded leaf-roller (*Cacœcia rosaceana*); an allied species, *Lozotænia clemensiana;* the raspberry sawfly (*Monophadnus rubi*); the raspberry leaf-roller (*Exartema permundana*); the common strawberry leaf-roller (*Phoxopteris comptana*), and the raspberry cane-borer (*Oberea bimaculata*). Most of these were exceedingly numerous and were equally scarce in former years. Some were discovered for the first time the present year on rosaceous crop plants in this vicinity.

ON SPECIES COMMON TO NORTH AND SOUTH.

Thus far we have considered insects which are for the most part distinctly Southern, at least in their origin, or that are confined more particularly to the North or are at least more injurious there than far southward. Of the occurrence this year of species which are usually about equally abundant and troublesome in most States of the North and South, I am unable to draw any deduction. On the whole, however, many of these, which include a very considerable portion of our injurious species, were locally scarce, more so than in previous years, but the writer at present finds it impossible to account for this on the

[1] The reasons for the retention of the above name for the cabbage curculio will be given in a forthcoming bulletin.

score of the weather. For example, the squash ladybird, *Epilachna borealis*, which is a thoroughly acclimated species coming originally, though a great many years ago, from the South, was unusually troublesome in some localities and scarce in others. The same is true of *Diabrotica vittata*, the striped cucumber beetle.

Of periodically injurious species that were troublesome the present year about Washington, and that do not fall readily into either the Northern or Southern group, are the fall army worm (*Laphygma frugiperda*), grass bill-bug (*Sphenophorus parvulus*), pale-striped flea-beetle (*Systena blanda*), bean leaf-beetle (*Cerotoma trifurcata*), and the destructive green pea louse (*Nectarophora destructor* Johns. MSS.).

The fall army worm and other cutworms are not apparently very susceptible to changes of the weather. The bill-bugs hibernate in the adult stage, and in this condition are among the most difficult insects to destroy, being long-lived and exceedingly tenacious of life. The plant-lice, though delicate in structure, are really capable of enduring a considerable variation of temperature, and are to be found in activity after severe frosts and long after most insects have sought their winter quarters. It is matter of common observation that they are less affected by cold and by the sudden changes which destroy many insects in winter than by heat and dryness, or by dampness or humidity. Prolonged cloudy, wet, or humid weather favors their multiplication, because it is practically only in sunny weather that the parasites of plant-lice are active. The Chrysomelidæ, which includes the leaf-beetles and flea-beetles, with but few exceptions, hibernate as adults, and are also unusually vigorous when in this stage, the tobacco flea-beetle being apparently an exception.

COMPARISONS WITH OBSERVATIONS MADE IN OTHER STATES.

The observations conducted by the writer in Maryland, Virginia, and the District of Columbia just mentioned, and the deductions drawn therefrom, were independent of those reported by other economic writers, and to bring out this fact more clearly and to show that the conclusions were drawn from personal observation originally, the reports of Messrs. Johnson, Webster, and Quaintance on the same and similar insects, as well as those of Messrs. Marlatt and Scott on the effect of the recent weather on scale insects, are referred to in different paragraphs. The manuscripts from which the notes which follow are taken reached me about the middle of September, after most of my observations had been written down, and as the papers in question have already been published in a previous bulletin of this series (Bul. No. 20, n. s.), where particulars are given, the different species will be only briefly mentioned.

To begin with, the different species reported by Professor Johnson as injurious during the season in Maryland, the currant worm, *Pteronus ribesii*, was described as a serious pest throughout the State, and was

reported also to have done much injury at Henderson, Ky. The grape-vine flea-beetle, *Haltica chalybea*, which may be considered a Northern species, was also very abundant in the northern part of Maryland and many complaints were made of injury to grape leaves and unfolding buds. The harlequin cabbage bug was so rare in the State as to have been mentioned by Professor Johnson as hardly to have been seen by him during the season, only one complaint having been received at his office, as compared with very serious injury inflicted the previous season. The imported cabbage worm, *Pieris rapæ*, "continued its depredations without any perceptible diminution."

Mr. Webster's experience with the harlequin cabbage bug in Ohio was similar. He says that it "certainly sustained a severe repulse by the low temperature of the last winter. * * * Its almost entire absence has been reported in localities where last year it was disastrously abundant." *Exartema permundana* was concerned in injury to black-berry in Ohio, having been reported from Wayne County in May.

Finally, from Mr. Quaintance's very full report on insects injurious to the trucking industry in Georgia during the year, it will be seen by comparison with his paper that those Southern species which were rare the present season about Washington were fully as abundant as in previous years in the South, additional proof that the weather was the responsible factor in reducing the numbers of these pests near Washington. Included in his list of troublesome species of the year are *Allorhina nitida*, *Heliothis armiger*, *Diatræa saccharalis*, *Margaronia nitidalis*, *Pionea rimosalis*, and *Murgantia histrionica*.

SPECIES THAT WERE CONTROLLED BY PARASITES AND DISEASE.

Two species somewhat generally attributed to the South, but so well distributed northward as hardly to be considered truly southern, were also rare; but this rarity is evidently due in part to other causes besides low temperature which, however, probably assisted in reducing the numbers of these pests.

The cabbage looper, *Plusia brassicæ*, which has shared with the harlequin cabbage bug the distinction of being the most troublesome of our garden pests in past years, and which was extremely abundant in the season of 1898, was not to be found at all the present year until about the middle of August, and then very rarely. The larvæ of the last generation of 1898 were quite extensively parasitized, and this undoubtedly served as a check on the species the past season.

Protoparce carolina was much less abundant the past year than the northern *P. celeus*, except in one single locality, where only the former was found. The previous year there was no such great disparity in numbers, but it is by no means certain that the weather was the important factor in the present case, as both species may be largely influenced as regards abundance or rarity by their parasitic enemies and diseases. All of the *carolina* observed were badly parasitized,

and it seems probable that we will have no such numbers the coming season.

Both of the above species are quite subject to bacterial and other diseases, and diseased individuals of both were noticed, but the extent of infection was not estimated.

No complaints of injury by either species in any portion of the country have come to my knowledge, although a few specimens were sent in by correspondents in the South. In this connection comparison is made with the observations of Messrs. Johnson and Quaintance. The former reported the cabbage looper as having ruined hundreds of acres of cabbage in Maryland in 1898, but hardly a specimen was obtained in the trucking areas the present year. In Georgia, according to Mr. Quaintance, only a single larva was observed. The experience of the latter gentleman as to the comparative abundance of the two tobacco worms agrees with my own.

It would seem probable also that the pickle worm owes its destruction to other causes than temperature, since the same rarity has been noticed in Georgia as about the District of Columbia. A bacterial disease is suspected, as the related *nitidalis* has been observed by the writer to die from this cause.

From the examples given it is reasonably plain that weather which is unfavorable to insects properly belonging to the Lower Austral life zone and which extend their range into the warmer portions of the Upper Austral, as in and near the District of Columbia, may favor the development of Transition forms, and *vice versa*. With our knowledge of the effect of the latest cold spell we ought to be able to predict with tolerable certainty, provided other forces with which we are unacquainted are not also at work, a similar result following the same or similar conditions in future years.

As regards the immediate future, there is every probability that the conditions in the region under consideration, as well perhaps as in other regions having the same fauna, will not be materially changed next year from what they have been the past season; and if the prediction of some wiseacre whom the writer has seen quoted that the winter 1899–1900 will be a severe one is verified, there is strong probability of a continuance of present conditions, leading perhaps to an even greater decrease in southern forms and to a corresponding increase in northern species.[1]

PROBABLE DECREASE IN INJURY TO CUCURBIT AND CRUCIFEROUS CROPS.

It will be noticed by anyone who is conversant with the habits of the insects enumerated as being affected by atmospheric changes, parasites, and diseases, that it includes a considerable number of those which attack squash, cucumber and other cucurbit crops; cabbage, turnip and other cruciferous plants, and rosaceous and other small fruits.

[1]The writer does not desire to be understood as in any way forecasting the future, but merely as expressing the belief that certain results would naturally follow certain conditions.

In the case of the cucurbits these are of tropical origin, and the insects which affect them are for the most part to be found in the Tropics, from which region they have extended in comparatively recent times north of the Lower Austral life zone. The squash-vine borer will probably not suffer any great diminution, but the pickle worm and the melon caterpillar, being more truly southern and being apparently actually absent from this region at the present time, will doubtless require several years before they can regain a foothold here, such at least as the former species had in 1897 (See Bulletin No. 19, p. 41). The leaf-footed plant-bug and horned squash bug are somewhat better calculated to survive a cold spell than many species so distinctly Lower Austral as these appear to be.

The pests of cabbage and other cruciferous crops have been controlled more particularly by parasites, although the weather doubtless assisted greatly. If I may be understood as being more specific without being subject to the charge of prognosticating, I would say that the harlequin cabbage bug should be on the whole rare next year at the beginning of the season, though it may be fairly abundant in some few limited localities, particularly late in the season and in the absence of an attempt to control it. Even in the case of the last generation, which appears to be the third, this was so small in individuals in 1899 that under any circumstances enough should not survive to work extensive injury. Such specimens of the cabbage looper as were collected here and received from the South were mostly parasitized, and this species ought to be held in check by its parasites alone. The imported cabbage butterfly, though numerous early in the season, was apparently almost completely killed off by parasites. As the cabbage Pionea was not once observed all season in 1899 further comment is superfluous.

Leaving out the insect enemies of cucurbits and cruciferous crops, which have been largely reduced in this region by the cold spell or parasites, there remain for cucurbits a few species of importance. These include the striped cucumber beetle, common squash bug, melon louse, and squash ladybird. Parasitic and other natural enemies of the first three were noticed to be unusually active throughout the season and their services should have due effect in decreasing the pests for another year, but in spite of these it may happen that any one or all four will be troublesome, at least locally.

Of the principal specific cruciferous plant pests which have not been mentioned, the cabbage louse, diamond-back moth, and flea-beetles, were all present during the year, but not in sufficient numbers to justify any fear that any of them will be especially and extensively troublesome next season.

PROBABLE DECREASE IN OTHER INSECTS AFFECTED BY COLD.

Of other pests mentioned as rare during 1899 on account of the severity of the winter, the tobacco flea-beetle, imbricated snout-beetle, garden webworm, and corn stalk-borer will probably not again resume

their abundance of recent years for one or more seasons to come, unless unknown influences are involved.

We can scarcely expect future scarcity of the corn-ear worm unless another severe and blizzard-marked winter is in store, as this insect increased in numbers with the advance of the season until, toward the closing days of September, it was fairly abundant in corn fields, though not injurious in gardens. The immediate future of the American locust is also doubtful. Both of these species are strong fliers, and favorable winds might bring either in considerable numbers and to a great distance northward in a year or two and the two species again be as common as ever.

NORTHERN SPECIES APPARENTLY BENEFITED BY COLD WINTERS.

This brings us to the subject of the species which are more at home in colder regions, and which were apparently benefited by the cold spell in their hibernation. A study of the insects affecting strawberry, blackberry and other rosaceous garden crops in the vicinity of the District of Columbia goes to show that we have in this region only one species which is really of prime importance in ordinary years, the strawberry weevil, which it might be mentioned was reported injurious the past year as in nearly every year for the past decade and more. The other insect enemies of these crops are, with scarcely an exception, Northern species, and we may expect a continuance and possibly an increase of these provided the cold weather prevails throughout the winter 1899–1900. The same is true of the insects which affect the currant and gooseberry, only one of which, the imported currant worm, has been noticed injurious in this vicinity in recent years.

SOME GENERALIZATIONS.

Finally, I wish to emphasize a remark made by Dr. Howard in a discussion of the geographical distribution within the United States of certain insects injuring cultivated crops and brought out in referring to the American locust (Proc. Ent. Soc. Wash., Vol. III, p. 225), which my own observations substantiate. It is that in certain forms of insects the winter temperature must have some effect in determining distribution. While admitting that the past winter was exceptional as regards temperature, the writer feels confident in carrying conclusions still farther in stating that in his opinion, based upon the study of the effect of that winter on injurious Northern and Southern forms of insects occuring in that portion of the Carolinian or humid life areas of the Austro riparian and Alleghanian zones (a climate like that of the District of Columbia), mean winter temperature has more effect upon determining the rarity or abundance of these species than has the mean summer temperature. These observations tend to show, also, what has

been long known in regard to plant growth and theoretically of insects, that sudden changes in the winter temperature, such as "freezes" or severe and protracted cold "snaps" which sometimes follow unseasonably warm spells, are more inimical to insect life here (and particularly when these occur after warm, sunny days in early spring or late winter when many species are tempted to issue prematurely from their winter quarters) than are hot spells in summer or autumn and periods of long drought.[1] In Kansas and other States of the middle West, and especially southward in the arid region of the Upper and Lower Austral (Sonoran) areas, the contrary, according to Mr. Marlatt, is true owing to the greater frequency and length of droughts in that region.

During the entire season of 1899 not a single instance came under notice of an insect which was lessened in numbers to any appreciable extent by atmospheric conditions existent during the summer. During the season of 1896, on the other hand, it was noticed of two species, the Colorado potato beetle and the common asparagus beetle,[2] whose larvæ feed freely exposed upon their host plants, that the intense heat of that summer had the effect of killing them off in a very marked degree.

It also appears to me what has been observed by Mr. Marlatt in the case of scale insects (Bul. No. 20, n. s., p. 73), is true in general, viz, that favorable or unfavorable climatic conditions are of greater importance in determining the abundance or scarcity of insects as a whole than are other natural checks such as parasitic and other enemies, or even fungous or bacterial diseases.

The year that has just passed, with its blizzards and low temperatures, was an exceptional one, and for that very reason had so striking an effect as to have called forth general remark on the part of the botanist, fruit grower, and in fact all others interested in plant life as well as the entomologist, and it is in just such years that we are best able to observe the effect of the weather and to draw conclusions as to the particular factors which conduce toward the preservation of the balance of nature.

[1] This subject is treated more fully by Dr. Howard in his article, entitled "Temperature experiments as affecting received ideas on the hibernation of injurious insects," and in the discussion which followed the presentation of that paper before the meeting of the Association of Economic Entomologists in 1897 (Bul. No. 9, n. s., pp. 18, 19). It was conclusively shown by Dr. Howard, through an experiment conducted by Dr. A. M. Read, with larvæ of *Tineola biselliella* and *Attagenus piceus*, that a consistent temperature of 18° F. would not destroy these insects, but that an alternation of a low temperature with a comparatively high one invariably resulted in the death of both.

[2] The latter species affords an excellent example of the effect of temperature in limiting the distribution of an introduced insect northward and southward, the cold "snaps" killing off the hibernating beetles in the northern limits of the species and the hot dry spells of summer effecting a similar result in respect to the larvæ in its southern limit (see writer's remarks in Yearbook Dept. Agr. for 1896, p. 374).

The subject is one of considerable interest and promise, but fraught with difficulties. In the writer's opinion, several years of careful study of different species, and particularly of most of those which have recently been under observation, together with all of the elements which tend to produce an increase or decrease in their numbers, would be productive of definite conclusions as to the cause of these fluctuations.

FOOD PLANTS AND INJURY OF NORTH AMERICAN SPECIES OF AGRILUS.

By F. H. Chittenden.

At the time of the publication of an article on the bronze birch borer, *Agrilus anxius* Gory, in Bulletin No. 18 (n. s., pp. 44–51), which appeared in January, 1899, it was intended to include some observations on the habits of other species of Agrilus, together with a summary of the known host trees of other North American species, and the paper which is presented here was prepared with that intention. Lack of space, however, prevented its publication at that time, and it is now presented as a separate article, together with a few additions resulting from observations during the past season.

The Buprestid genus Agrilus includes five species which have been reported to be injurious to birch and poplar, chestnut and oak, Lombardy poplar, raspberry and blackberry, and pear trees, respectively; and there is strong likelihood that some others, which will receive mention in this article, may assume destructive habits at any time. In the notes which follow special mention of injury by different species of Agrilus a summary is given of all the North American species whose food habits are known, together with their host plants, dates of appearances, and references to published records of their habits.

In the preparation of this portion of the article the writer has made free use of Divisional notes and is particularly indebted to Mr. E. A. Schwarz for kindness in placing at his disposal many unpublished notes based on the observations of the late H. G. Hubbard and himself on the food plants of species mostly of the Southwestern States.

THE BRONZE BIRCH BORER.

As the subject of the biology and remedies to be applied to this species has lately become a special study on the part of Prof. M. V. Slingerland, of the Cornell University Agricultural Experiment Station, it has not been given the same attention at this office since the publication of the writer's former article on this insect that would otherwise have been given it. A few facts, however, have been reported by correspondence and others have come under observation through office rearings which are of interest and which may be appropriately recorded here in connection with what will be said concerning other species of the same genus.

Further reports of conditions at Buffalo, N. Y.—In a letter dated December 2, 1898, Mr. M. F. Adams stated that the trees in Delaware Park, Buffalo, N. Y., were infested at a time prior to those in which the insect was first discovered and subsequently reported to this office. It was learned from some of the park employees that the health of the birch trees there were impaired by a little sapsucker presumed to be *Picus (Dryobates) pubescens.* This bird was believed to have seriously injured the trees, which brought the condition of the sap to the liking of the borer, and it multiplied so freely that it was afterwards driven to attack and has been the primary cause of the death of many healthy trees. This was effected through the carelessness of allowing the first trees attacked to remain standing, or in wood piles, all of which aided in the accumulation of the pest.

On the other hand, our correspondent states that a tree which he had under observation during the past few years, and which is located on the outskirts of the city, was until very recently in apparently vigorous condition. It did not show the attack either by a plant-louse (presumably a species of Callipterus), which was found in a central part of the city, nor the sapsucker which injured the trees in Delaware Park. It had plenty of fertilizer in the way of manure water, etc., and many remarked what a beautiful and healthy tree it was. Toward fall, however, it began to show signs of infestation by this insect and upon examination it was found to be seriously affected in the larger limbs.

In the central part of the city our correspondent believes that this plant-louse has brought the trees to a condition that has subjected them to the attack of the birch borer.

Reported occurrence in the West.—June 11, 1899, Prof. F. C. Newcombe, of the University of Michigan, Ann Arbor, Mich., wrote that what was without doubt this species, and which he designated as the white-birch borer, had been in that locality for two or three years and had killed half the white birches in the city of Ann Arbor.

Recent office observations.—From samples of infested wood sent from Buffalo by Mr. Adams the following spring and kept in a cool place in as near natural conditions as possible the beetles began issuing the second week of May. Possibly in a more sunny exposure they might issue as early as the first week of May.

A single parasite was reared, the chalcidid *Phasgonophora sulcata* Westw. which began issuing about two weeks after the adult beetles and continued after they had all issued from the wood.

This parasite has other hosts as it has been reared by the writer from Japanese redbud (*Cercis japonica*) infested by *Chrysobothris femorata*, the most likely host. Adults issued July 8, Washington, D. C.

AGRILUS OTIOSUS SAY: A SPECIES LIKELY TO PROVE TROUBLESOME.

March 12, 1887, pieces of bark of maple infested by the larvæ of a species of Agrilus were received from Mr. F. M. Webster, at that time located at Lafayette, Ind. Mr. Webster stated in his accompanying

letter of March 10 that within a year a whole row of maple trees on a street had died, one after another, and the trees were then being dug up. An investigation of the trees disclosed the presence of numerous larvæ of Agrilus, which our correspondent believed to be the cause of the trouble. In our rearing cages the beetles began to issue April 18, continuing until the 23d. The species concerned proved to be *Agrilus otiosus* Say.

During the spring of 1893 all stages of this Agrilus were taken by the writer in abundance on a dying tree of the flowering dogwood (*Cornus florida*) growing in the suburbs of Washington, in the District of Columbia. Field observations began during the first week of May and continued until the end of the month. May 18 the majority of the insects were turning to imagos, some having developed at that time. Larvæ taken from the pupal chamber May 6 transformed to pupæ on the 13th and to imagos the 28th, the duration of the pupal stage having been fifteen days. The pupal cells were constructed in the wood just beneath the bark and at varying angles to the grain of the wood, seldom at right angles, though often approaching it. The exact dimensions of the galleries and their general character were not observed at this time further than to note that in these respects the work of this species resembled that of the two-lined chestnut borer, *A. bilineatus*.

Dogwood appears to be the favorite food tree of this species, but it is probably a somewhat general feeder. The writer has reared the beetles from butternut and redbud (*Cercis canadensis*) in June, and has seen individuals sunning themselves on dead box-elder under such circumstances as to lead to the belief that this was also a food plant; and there is record in Packard's Fifth Report of the United States Entomological Commission (p. 376) of the beetles of this species feeding on freshly formed foliage at the tips of new growths of locust. Dr. Blanchard, in his list of Massachusetts Buprestidæ (loc. cit.), notes the common occurrence of this species on oak shrubs in June and July, and the late Dr. John Hamilton (Tr. Amer. Ent. Soc., Vol. XXII, p. 364) adds that it breeds in oak. Dr. A. D. Hopkins states that it "infests bark on dead twigs and branches of hickory and black walnut," the adults being found from April 14 to July 25. (Bul. No. 32, W. Va. Ag. Exp. Sta., p. 183.) The same writer has mentioned the attack of some species of Agrilus, perhaps the one under consideration, on *Cornus florida*. (Insect Life, Vol. VII, p. 198.)

In the writer's experience it infests particularly the larger limbs of its host trees.

THE TWO-LINED CHESTNUT BORER.

July 8, 1899, Mr. C. G. Hatcher, Macon, Ga., sent specimens of the larva of what is with little doubt *Agrilus bilineatus* Weber, with report that it threatened the extermination of the wild chestnut trees on his plantation in Crawford County, Ga. Fifty years ago, he writes, the

chestnuts were abundant in that section, but are now on a steady and swift decline. The specimens sent were taken from a large tree about half dead and very badly infested with this borer, the leaves having wilted at this time. The characteristic channels of this species of Agrilus could be seen on the trunk to a distance of about 7 feet, running under the bark across the cambium. The insect appeared to kill the trees about the month of May, the trees dying in a few weeks after attack (presumably after the emergence of the adults), the leaves looking as if they had been scorched.

LIST OF SPECIES AND THEIR FOOD PLANTS.

A. abductus Horn.—Observed by the late H. G. Hubbard and by Mr. E. A. Schwarz at Oracle, Ariz., on *Quercus arizonica*, July 7 (unpublished note).

A. abstersus Horn.—Reared by Hubbard and Schwarz from twigs of *Acacia greggii* at Santa Rita Mountains, Arizona, in May (unpublished).

A. acutipennis Mann.—On foliage of oak shrubs, June, July, Mass.—Blanchard (Ent. Amer., Vol. V, p. 32). A variety was taken by Dr. Blanchard on poplar sprouts (Tr. Am. Ent. Soc., Vol. XVIII, p. 308).

A. anxius Gory.—The bronze birch borer. Injurious to birch (*Betula alba, papyrifera*, etc.), and willow (*Salix discolor*) and probably to poplar, June, July, central and western New York.—See writer's article in Bul. No. 18, n. s., Div. Ent., pp. 44–51.

A. arcuatus Say.—Beaten from oak, elm, and hazel.—Stromberg, Can. Ent., Vol. XXVI, p. 36. Var. *coryli* "On the hazel" (*Corylus americana*), June, July, Mass.—Blanch. (l. c.).

A. bilineatus Weber.—The two-lined chestnut borer. Injurious to living chestnut (*Castanea dentata*) and oak of several species, May–July, D. C.—See articles by writer in Bul. No. 7, n. s., Div. Ent., pp. 67–75; Circ. No. 24, 2d ser., pp. 1–8. Mr. Harrington has taken it upon beech and believes it to infest that tree (Rept. Ent. Soc. Ont. 1896, p. 71).

A. couesii Lec.—"On *Mentzelia nuda*" Santa Fé, N. Mex., Aug. 3.—T. D. A. Cockerell (Journ. N. Y. Ent. Soc., p. 150, Sept., 1897).

A. cuneus Lec.—Bred from *Croton capitatum;* also occurs on *Croton eleagnifolium* in Texas.—Schwarz (unpublished note).

A. *difficilis* Gory. (*occidentalis* Uhler).—"Obtained from a species of willow," Indiana—Uhler (Proc. Ac. Phila., Vol. VII, p. 416, 1855).

A. egenus Gory.—Infests locust (*Robinia pseudacacia*), mining under the bark and twigs of the smaller branches, the beetles eating the leaves.—See notes by writer in Entomologica Americana, Vol. V, p. 219; hickory (*Hicoria alba*).—Reared by the writer and others. Reared from *Robinia neomexicana* in Arizona by Hubbard and Schwarz.

A. fallax Say.—Habits similar to *egenus*. In the National collection is a series from central Missouri labeled by Dr. O. Lugger "on locust," and another series from Iowa similarly labeled by the late Dr. C. V. Riley. Among Divisional notes is one of the occurrence of what is stated to be this species under the bark of cottonwood in July. "Infesting bark and wood of dying branches on living and dying hackberry." (*Celtis occidentalis*).—Hopkins (Bul. No. 32, W. Va. Ag. Expt. Sta., p. 184). Beaten from oak—Stromberg (l. c.)

A. felix Horn.—Reared from "Palo verde" (*Parkinsonia microphylla*) at Catalina Springs, Ariz.—Hubbard and Schwarz (unpublished note).

A. floridanus Crotch.—Observed by Mr. Schwarz at Tampa, Fla., on Quercus.

A. granulatus Say.—The Lombardy poplar borer. Injurious.—T. J. Burrill (12th Rept. St. Ent. Ills., pp. 121, 122; Fifth Rept. U. S. Ent. Com., pp. 443, 444). "Breeds

in and frequents the stems of partly dead alders" (Alnus) June-July. Mass.—Blanch. (l. c.).

A. imbellis Crotch.—"Occurs on *Helianthemum canadense* in June to August. Mass."—Blanch. (l. c.). Common, according to Mr. Schwarz, near Washington, D. C., in meadows.

A. impexus Horn.—"Occurs on the two locusts (*Gleditschia triacanthos* and *Robinia pseudacacia*), July and August." Galesburg, Ill.—Stromberg (l. c.).

A. interruptus Lec.—Probably breeds in oak. June, July, Mass.—Blanch. (Ent. Amer., Vol. V, p. 32). Also taken by the writer on this tree. Found "upon beech, birch, and hickory."—Harrington (Rept. Ent. Soc. Ont. for 1896, p. 71).

A. lateralis Say.—According to Dr. Horn, this is the species mentioned in Blanchard's list under the name *anxius* as having been taken as adult upon foliage of poplar sprouts. July, Mass. (l. c.).

A. lecontei Saund.—"Not rare on hackberry (*Celtis occidentalis*), June and July." Galesburg, Ill.—Stromberg (l. c.). The writer has observed it upon the same tree about Washington, D. C., in July, and Mr. Schwarz has observed this species on Celtis from Michigan to Arizona, and believes it to live on that tree wherever the latter occurs.

A. macer Lec.—Very injurious, according to Mr. Schwarz, to *Celtis occidentalis* in Texas (unpublished note).

A. masculinus Horn.—On box-elder (*Negundo negundo*). July, Galesburg, Ill.—Stromberg (l. c.).

A. obsoletoguttatus Gory.—"Quite common on red and laurel oaks, June." Galesburg, Ill.—Stromberg (l. c.).

A. ornatulus Horn.—Breeds in huisache (*Acacia farnesiana*) in Texas.—Schwarz (unpublished note).

A. otiosus Say.—Attacks and is likely to prove injurious to maple, dogwood (*Cornus florida*), redbud (*Cercis canadensis*), hickory (*Hicoria* spp.), black walnut (*Juglans nigra*), and probably also infests butternut, box-elder, oak, and perhaps locust. May-July (ante).

A. palmacollis Horn.—Reared from twigs and branches of mesquite (*Prosopis juliflora*) and huisache (*Acacia farnesiana*) collected by Mr. Schwarz at San Diego and Brownsville, Tex.

A. politus Say.—"Infests green bark on living willow trees. May be the primary cause of death of young trees." June, W. Va.—Hopk. (l. c.). "Common, on *Salix obtusifolia*, June," Pa.—Hamilton (l. c.). Also observed by Dr. Blanchard (l. c.) and the writer on willow. On hazel.—Brûner (unpublished note).

A. pulchellus Blanch.—Breeds in roots of Erigeron in Arizona.—Hubbard and Schwarz (unpublished note).

A. ruficollis Fab.—The raspberry gouty-gall beetle; red-necked cane borer. Injurious to raspberry, blackberry, and dewberry (*Rubus* spp.) June and July.—Various writers.

A. scitulus Horn.—Reared by Mr. Schwarz from huisache (*Acacia farnesiana*) at San Diego, Tex.—Unpublished.

A sinuatus, Ol.—The sinuate pear borer.—Injurious to pear trees in New Jersey. May, June.—J. B. Smith (15th Rept. N. J. Agl. Expt. Sta. for 1894, pp. 550–561, etc.); Riley and Howard (Insect Life, Vol. VII, pp. 258–260). In Europe attacks also white thorn, medlar, and mountain ash (l. c., p. 556).

A. rittaticollis Rand.—"Taken occasionally in June feeding on the leaves of thorn (Cratægus), shad bush (Amelanchier) and chokeberry (*Pyrus arbutifolia*). Mass."—Blanch. (l. c.). "Seems to live on the shad berry (*Amelanchier canadensis*)."—E. P. Austin (Pr. Bos. Soc. N. H., Vol. XVII. p. 276, 1875). "Rare, on Kalmia and chestnut."—Hamilton (l. c.).

Agrilus sp.—Lives in stems of *Jatropha multifida*, Catalina Springs, Ariz.—Hubbard and Schwarz (unpublished note).

EXPERIMENTS WITH HYDROCYANIC-ACID GAS AS A MEANS OF EXTERMINATING MEALY BUGS AND OTHER INSECT PESTS IN GREENHOUSES.[1]

By H. D. HEMENWAY, *Amherst, Mass.*

THE USUAL METHOD.

Hydrocyanic-acid gas has been known and used in the West for fumigation of nursery stock and trees infested with scale since its introduction by the Division of Entomology of the United States Department of Agriculture in 1886. We have no record of its being used in greenhouses until 1895, when, under the direction of Messrs. Woods and Dorsett, of the Department, it was used successfully on ferns, coleus, and in violet houses for the destruction of scales, mealy bugs, and aphides or plant-lice.[2] It has been used to a limited extent since that time, but not, as a rule, in fumigating greenhouse stock in general. For many years in the large greenhouses connected with the Massachusetts Agricultural College, great expense has been incurred in destroying mealy bugs and scale insects on the vines, palms, orange trees, acacias, etc., and after a thorough trial of fir-tree oil, lemon oil, and other insecticides, many of which proved of some value, but were not wholly satisfactory, it was decided to try hydrocyanic-acid gas, the most powerful insecticide known. As the common mealy bugs known in every old greenhouse are very prolific breeders, each female averaging 400 eggs, and with a prospect of a new generation every six weeks, it became apparent that if we wished to keep plants in good condition we must exercise constant vigilance or occasionally resort to some heroic measure.

After several preliminary experiments with some of the more delicate plants in a wooden box the stove and cactus rooms were fumigated at the same time, the connecting doors between the two rooms having been opened. Many of the cacti were infested with the common cactus scale (*Diaspis cacti*), while in the stove room all through the twining vines was to be seen the flocculent network of white, waxy threads protecting the eggs and young mealy bugs.

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[1] The manuscript of this paper was submitted to the Division of Vegetable Physiology and Pathology of this Department and kindly examined by Messrs. Galloway, Woods, and Dorsett, all practical violet growers and the perfecters of the hydrocyanic-acid gas method as far as it relates to the treatment of insects in greenhouses. They point out that while the results obtained by Mr. Hemenway may hold good for the conditions under which the trials were made, they will not necessarily do so in a different environment, since it has been found in practice that a certain kind of plant will be injured at one time in one section of the country and will show no signs of injury at another time in the same section or in some other locality. In other words, it would not be safe to use the gas on the same varieties of plants in other sections on the evidence furnished by these experiments.—ED.

[2] Circular No. 37, Division of Entomology, U. S. Department of Agriculture.

The materials used in fumigating were as follows:

TRIAL I.

	Cubic feet space.	Amount potassium cyanide used.	Water.	Sulphuric acid.	Time.	Result.	Date.
		Oz.	*Oz.*	*Oz.*	*Min.*		
Cactus room....	7,076.25	[1]40	40	70	30	No injury...	Nov. 9, 1897
Stove room.....	7,357.31	40	40	70	30	.....do	

[1] 98 to 99 per cent pure.

Ordinary glazed earthen jars, holding 2 gallons each, were first placed in position. The potassium cyanide (40 ozs.) for each room was tied in double thickness of paper and suspended by means of a string playing over a support directly over the jars. This string was held by an attendant at the door. The water was put into the jars and then the acid. The cyanide was then lowered into the jars, the door being immediately closed. The room remained closed for thirty minutes and then the ventilators, which had been previously prepared, were opened from the outside. The temperature of the house was about 60° F. The conditions of the weather were perfect for such a test, as it was raining, the water filling the cracks in the house, and thus preventing the escape of the gas. It was also warm outside, so the house was not cooled too low while the ventilators were open, and it was perfectly dark. The ventilators were left open for over an hour and then closed for the night.

Results.—The room contained many different kinds of cacti, begonias in variety, passifloras, allamandas, bananas in fruit, ferns, palms, and a large variety of general stove plants. Not only were the mealy bugs, scales, and aphides destroyed, but a large per cent of the sow-bugs were found dead on the walks and under the moss which carpets the floor of the solid bed in the stove room. Even the earthworms on the surface of the soil under the moss were dead.

After this many experiments were made with different plants and insects put in a glass box containing about 42 cu. ft. of space; also several practical tests were made in the greenhouse[1] (see table).

TRIAL II.

This was in a house containing 22,729 cu. ft. of space, using 1 oz. potassium cyanide to every 285 cu. ft., with $1\frac{3}{4}$ oz. sulphuric acid and 1 oz. of water. This house contained carnations, smilax, violets, coleus, chrysanthemums, small lettuce, cuttings, and small plants of bedded stock. It was infested with the common mealy bugs (*Dactylopius destructor*), green fly, and the white-tailed mealy bugs (*Orthezia insignis*). It was fumigated for 30 minutes upon a cloudy morning, yet in daylight. The

[1] It is to be regretted that no notes were kept on the effect of this treatment on the plants.—L. O. H.

insects were mostly killed, but some of the plants were badly injured. This was especially true in case of the smilax, the upper leaves of the carnations, and the lettuce. Much of the latter, which was very small and in full light, was killed, while some that was shaded showed much less injury. The smilax and carnations recovered in time, but received a severe check. As will be seen later, smilax and more delicate plants have been subjected to double the strength of gas *in darkness* without injury.

EXPERIMENT I.

Conditions.—Made Nov. 27, 1897, in sunlight, in a glass box containing nearly 42 cu. ft. The following proportions were used: 2.1 grams (1 oz. cyanide of potassium to 570 ft.) of potassium cyanide, liberated with 2.1^{cc} water and 2.1^{cc} sulphuric acid; temperature of box, 63° F.; plants treated were *Asparagus plumosus*, veronicas, roses, cinerarias, begonias, and chrysanthemums; the insects upon these plants were mealy bug, "green fly," scale, and Fuller's rose beetle (*Aramigus fulleri*); there were 2 plants each of smilax and roses, one sprinkled with water, the other dry. The box was closed for 30 minutes.

Results.—Some of the green flies commenced to drop in three minutes. There was no apparent injury at close of fumigation, but December 2 nearly all plants showed some injury. Most of the insects were killed, but the rose beetles were not much injured.

EXPERIMENT II.

Conditions.—Made November 27, 1897, in same glass box; in darkness; potassium cyanide used, 1 oz. to 285 cu. ft., with same proportions of acid and water as before; temperature 55° F.; time fumigated, 25 minutes; plants used: 2 genistas, 2 cupheas, 2 veronicas, and 2 coleus; insects: mealy bug, green fly, white-tailed mealy bug, scales (*Aspidiotus rapax* and *A. ficus*).

Results.—All insects dead; no injury to any of the plants. A comparison of these two experiments shows that the first lot treated in sunlight were all injured while those treated in darkness with double the strength of hydrocyanic acid gas were uninjured.

EXPERIMENT III.

Conditions.—Made November 28; glass box; dark; potassium cyanide used, 1 oz. to 190 cu. ft., with 1 oz. water and $1\frac{3}{4}$ oz. sulphuric acid (see table); temperature, 47° F.; time fumigated, 20 minutes; plants: calla, ferns, cineraria, genista, cuphea, camphor tree; insects: scale, rose beetles, mealy bug, and aphis.

Results.—All insects excepting rose beetles killed; no plants injured.

EXPERIMENT IV.

Conditions.—Made November 29, 1897; glass box; darkness; potassium cyanide and conditions same as in No. III (see table); time fumigated, 20 minutes. In this experiment an attempt was made to watch the effects on Fuller's rose beetle.

Results.—In 5¼ minutes after fumigation commenced beetles on the plants dropped, and those on the surface rolled over and drew themselves together, apparently dead. About one hour after fumigation they all recovered.

EXPERIMENT V.

Conditions.—Glass box; darkness; same as above except that time of exposure was 25 minutes.

Results.—Same as in No. IV.

EXPERIMENT VI.

Conditions.—Made November 29, 1897; darkness; 1 oz. potassium cyanide, 1 oz. water, 1¾ oz. acid to 142 cu. ft. (see table); plants: cinerarias (1 sprinkled with water, 1 dry), smilax (1 sprinkled, 1 dry), ferns; insects: rose beetles; time, 25 minutes.

Results.—Plants not at all injured; nearly all beetles killed.

To destroy the rose beetle it will probably be better to use less strength of gas and place sheets of paper or canvas beneath the plant infested, than to use the larger percentage of cyanide, as they are sure to drop off when the house is fumigated with sufficient strength of the gas to kill mealy bugs. They can then be gathered up and destroyed.

TRIAL III.

Conditions.—Date, November 27, 1897; place, rose room; 1 oz. potassium cyanide, 1¾ oz. acid, and 1 oz. water to 570 cu. ft.; room contained only roses, the new shoots being covered with green fly; length of time fumigated 25 minutes (see table).

Results.—All aphides were killed, but the tender buds and leaves of the plants were injured.

TRIAL IV.

Conditions.—Time, November 29, 1897; place, octagon room; 1 oz. potassium cyanide, 1 oz. water, 1 oz. sulphuric acid to 175 cu. ft. (see table). In this room, containing 25,689 cu. ft. of space, three jars were used with 49 oz. of cyanide to each jar. In this room was a large number of tropical plants, trees, and ferns. It was very badly infested with mealy bugs and scale, beetles, and aphides.

Results.—Very satisfactory; many of the beetles dropped on the walk and died. The only injury noted on December 20 was on the climbing Perle des Jardins rose, but this was not serious. The tree fern, which was very badly infested with mealy bugs, has sent out several new fronds. The manettia vine, which had its growth checked by mealy bugs, now has long growing shoots and is covered with blossoms. In fact, all the plants in this room have made new and decided growth.

TRIAL V.

Conditions.—Place, camellia room; 1 oz. potassium cyanide, 2 oz. water, and 1 oz. sulphuric acid to 190 cu. ft. (see table); insects

present were aphis, mealy bug, white-tailed mealy bug, scale insects. In this room was a collection of cool-house plants. A difference in the proportions of water, acid, and cyanide will here be noticed.

Results.—In the previous experiments it was found that although there was always an excess of acid present, some of the hydrocyanic acid was not liberated, owing to the fact, probably, that potassium sulphate was formed and became crystallized upon the surface before all the potassium cyanide below was reached by the acid. For this reason more water was added to hold the potassium sulphate in solution longer. In this trial, however, there proved to be too little sulphuric acid to generate heat enough to rapidly liberate the gas, and hence some of the potassium cyanide was not decomposed at the end of the fumigation. Under these circumstances this trial was not wholly successful, as only the aphides were killed.

TRIAL VI.

Conditions.—Place, camellia room; 1 oz. potassium cyanide, 2 oz. water, and 1½ oz. sulphuric acid to 190 ft. of space (see table).

Results.—This trial was satisfactory, as no plants were injured and all insects were killed with the exception of the rose beetle.

THE "DILUTE METHOD" OF USING HYDROCYANIC-ACID GAS FOR FUMIGATING GREENHOUSES.[1]

Last year we worked with what I am going to call the concentrated method of using hydrocyanic-acid gas with results as previously shown—some satisfactory, some unsatisfactory.

The following will show the results of the "dilute method" of using the gas for fumigating greenhouses.

TRIAL I.

Conditions.—Date, January 17, 1899; place, camellia room; 1 oz. potassium cyanide, 1½ oz. sulphuric acid, and 2 oz. water to every 3,000 cu. ft. In this room, containing 6,196 cu. ft. of space, 2.06 oz. cyanide of potash, 4 oz. water, and 3 oz. sulphuric acid were used. It was fumigated at night about 6 o'clock, the room remaining closed until morning. The following insects were present: green fly, mealy bug, Fuller's rose beetle. The plants in this room at the time of fumigation were, coleus, azaleas in bloom, heliotrope, ferns, hoya, jasminums, polygala, hibiscus, ericas, orange trees, camellias, cinerarias, oxalis. The temperature went below 50° F.

Results.—Upon examination it was found that no plants were injured, and none of the insects save a part of the green flies.

[1] See article by Dr. J. Fisher, American Gardening, October 29, 1898, and Circular 37, before cited.

TRIAL II.

Conditions.—Date, January 17, 18 9; place, stove room; 1 oz. potassium cyanide to 3,000 cu. ft.; in this room, containing 7,357.31 cu. ft. of space, 2.45 oz. potassium cyanide, 5 oz. water, and 3¾ oz. sulphuric acid were used; the room fumigated after dark, remaining closed until morning; insects present were mealy bug, green fly in abundance, and Fuller's rose beetle; plants present: Grevillias, ferns, dracænas, palms, bananas, pandanas, strelitzia, begonias in variety, mahernias, passifloras, Hoffmannias, allamanda, ivy, sansevieria, aristolochia, agaves, heliotrope, cinerarias, callas, roses, etc.; temperature, about 50° F., or a little above.

Results.—Upon examination it was found no plants save the tender leaves of the roses were injured, while the aphides on the Hoffmannia and elsewhere were killed. The other insects were apparently uninjured.

TRIAL III.

Conditions.—Date, January 20, 1899; place, camellia room; all night; 1 oz. cyanide of potash to each 2,000 cu. ft.; 3.09 oz. potash cyanide, 6.2 oz. water, and 4.6 oz. sulphuric acid used; insects present: aphides, mealy bugs, Fuller's rose beetle; plants same as in Trial I.

Results.—Aphides all killed and a part of the mealy bugs; none of the older ones, however; no plants injured.

TRIAL IV.

Conditions.—Date, January 20, 1899; place, stove room; all night; 1 oz. potassium cyanide to each 2,000 cu. ft.; 3.7 oz. potash cyanide, 7.4 oz. water, and 5.5 oz. of sulphuric acid required; plants same as in Trial II, except roses; insects: mealy bugs and Fuller's rose beetle.

Results.—Part of mealy bugs killed; old ones not killed; no plants injured.

TRIAL V.

Conditions.—Date, January 23, 1899; place, camellia room; 1 oz. potassium cyanide to 1,000 cu. ft.; left in all night; 6.2 oz. potash cyanide, 12.5 oz. water, and 9.1 oz. sulphuric acid; the room was warmer than at other times, the temperature being over 50° F.

Results.—In afternoon of January 24, 25 or more mealy bugs were examined with a lens and all were dead. No injury to any of the plants was seen. At this fumigation there was no heliotrope or coleus. The other plants, including carnations, were the same as in Trial I.

TRIAL VI.

Conditions.—Date, January 23, 1899; place, lily room; 1 oz. potash cyanide to each 3,000 cu. ft.; left in all night; 1.76 oz. potash cyanide, 3.56 oz. water, and 2.64 oz. sulphuric acid required; temperature, 60° F. or over; plants present, philodendrons, water lilies (Nymphæas), parrot's

feather (*Myriophyllum proserpinacoides*), water hyacinth (*Eichhornia crassipes major*), water poppy (*Limnocharis humboldti*), *Cyperus alternifolius*, *Papyrus antiquorum*, oxalis, orchids in variety, roses, callas, ferns, New Zealand flax, cobaeas, caladiums, etc.

Results.—Upon examination the next day aphides were found all dead, although as yet not discolored, and remaining in their places. Of 11 mealy bugs examined, 6 were dead and 5 alive. There was no injury to any plant, except to the young foliage of the roses, which was burned.

TRIAL VII.

Conditions.—Date, January 28, 1899; place, second octagon room; all night; 1 oz. of potash cyanide to each 3,000 cu. ft.; 8.56 oz. of potassium cyanide, 17.12 oz. water, and 12.84 oz. sulphuric acid required; insects: aphides, mealy bugs, and beetles; plants present: ferns, callas, palms in variety, agaves, aspidistras, marantas, guavas, jasminums, loquat, durantas, ficus, manettias, pleromas, bananas, cordylines, yuccas, *Solanum jasminoides*, Cherokee and climbing perle roses, bamboo, abutilons, cytisus, etc.

Results.—Aphides were killed. On January 31, three days after fumigating, the only injury to plants was the burning of the tender leaves on the climbing perle rose, the tender leaves of the *Solanum jasminoides*, which was just starting into growth, and the new fast-growing shoots of *Asparagus tenuissimus*. The tender leaves of the Cherokee rose were slightly burned. Almost none of the bugs (at least none of the old ones) were killed; of 10 examined, at least 9 were alive; the temperature was rather low, however.

TRIAL VIII.

Conditions.—Date, January 28, 1899; place, first octagon room; all night; 1 oz. potassium cyanide to each 3,000 cu. ft.; 9.44 oz. cyanide of potash, 18.88 oz. water, and 14.16 oz. sulphuric acid used; insects: aphides and mealy bugs; plants present: asparagus (*plumosus*, *sprengeri*, and *tenuissimus*), palms, vincas, ferns, mosses, dracænas, eupatoriums, ipomœas, ficus (*elastica* and *religiosa*), cytisus, begonias, marantas, manettia, aspidistras, cyperus, etc.; the temperature was below 55° F.

Results.—Aphides were killed; but of 50 mealy bugs examined, mostly adults, however, only 8 were killed. No plants were injured, with the exception of the asparagus, which was sending out new and very tender growth.

TRIAL IX.

Conditions.—Date, February 15, 16, and 17, 1899; place, second octagon room; left in all night 3 nights in succession; 1 oz. cyanide of potash to each 3,000 cu. ft.; 8.5 oz. cyanide of potash, 17 oz. water, and 13 oz. sulphuric acid used each night; temperature averaged about 56° F.; the insects for which this trial was made were mealy bugs.

Results.—On the morning of the 16th our cat was found dead upon the walk near the entrance. She had evidently walked in the open door the night before, when I went in with the cyanide, and must have been killed in a short time. On the 18th 25 mealy bugs were examined with a lens and 18 were found dead; but this is not a correct percentage of those killed, for many of the dead ones on the plants were washed off by syringing the house previous to examination. The climbing roses, the tender leaves of the *Solanum jasminoides*, the new leaf buds of *Pleroma macranthum*, the new fronds of *Pteris tremula*, and the new shoots of *Asparagus tenuissimus* were all more or less injured. The other plants showed no injury.

TRIAL X.

Conditions.—Date, February 15, 1899; place, stove room; left in all night; 1 oz. potash cyanide to each 2,000 cu. ft.; 3.7 oz. potash cyanide, 7.4 oz. water, and 5.5 oz. sulphuric acid required; temperature, 55° to 60° F.; insects: mealy bugs and aphides.

Results.—In this room there was no injury to plants; all of the aphides were killed, and all mealy bugs examined were dead. This house was also fumigated with the same proportions on January 27.

TRIAL XI.

Conditions.—Date, February 16, 1899; place, vegetable house, west; 1 oz. potash cyanide to each 3,000 cu. ft.; left in all night; temperature, 56° F.; 2 oz. cyanide of potash, 4 oz. water, and 3 oz. sulphuric acid required; insects: an abundance of "green fly"; plants present: lettuce, radishes, papyrus, smilax, cinerarias, kale. The lettuce and cinerarias were badly covered with "green fly."

Results.—All or nearly all "green fly" killed, even under the lower leaves of the lettuce, which had commence to head. There was no injury to plants.

TRIAL XII.

Conditions.—Date, February 23, 1899; place, the pit; 1 oz. cyanide of potash to each 3,000 cu. ft.; left in all night; 3 oz. cyanide of potash, 6 oz. water, 4½ oz. sulphuric acid required; temperature, 47° F.; insects present: mealy bugs and "green fly"; plants: cinerarias, calceolarias, pelargoniums, geraniums, muehlenbergia, eupatoriums, nasturtiums, clematis, etc.

Results.—The aphides were nearly all killed, while the mealy bugs, the older ones at least, were not injured. There was no injury to plants.

TRIAL XIII.

Conditions.—Date, February 28, 1899; place, camellia room; 1 oz. cyanide of potash to each 1,000 cu. ft.; left in all night; temperature, 50° F.; 6 oz. cyanide of potash, 12 oz. water, 9 oz. sulphuric acid used; plants

present: carnations, figs, pomegranates, oranges, camellias, azalias, chrysanthemums, *Saxifraga sarmentosa*, polygala, hardy cuttings, etc.; insects: several hundred mealy bugs from vinca vines were picked, placed in a shoe box cover, and put in this room just before fumigating it.

Results.—Over 80 of the mealy bugs in the box cover were examined with a lens, but none of them were alive. No live ones were found anywhere in the room. The leaves of the figs and pomegranates, which were just beginning to come out, were injured. Some of the fig leaves that were partly formed dropped. The other plants were uninjured, excepting the tender veronicas.

TRIAL XIV.

Conditions.—Date, February 28 and March 2, 1899; place, the pit; 1 oz. cyanide of potash to each 3,000 cu. ft.; left in all night; 3 oz. cyanide of potash, 6 oz. water, and 4½ oz. sulphuric acid required; temperature, 54° F.

Results.—At the first fumigation, February 28, most of the "green fly" were killed, but not all, owing to the fact that the jar used in fumigating was too large, and the cyanide was not all immersed. On March 2 a smaller dish was used. There was no injury to plants in either case. The "green fly" were all killed the second time.

TRIAL XV.

Conditions.—Date, March 1, 1899; place, vegetable house, complete; 1 oz. cyanide to each 3,000 cu. ft.; left in all night; 4 oz. cyanide, 8 oz. water, 6 oz. sulphuric acid required; temperature average, 45° F.; insects: "green fly"; plants: headed to heading lettuce and small lettuce, small cabbages, parsley, old smilax, papyrus, hibiscus, strawberries, radishes, kale, and *Bellis perennis.*

Results.—In this trial the jar was too large and the liquid did not cover the cyanide, some remaining undecomposed until morning. The "green fly" were, however, nearly all killed. There was no injury to any plant.

TRIAL XVI.

Conditions.—Date, March 2, 1899; place, cactus room; 1 oz. cyanide to each 2,000 cu. ft.; left in all night; 3.5 oz. of cyanide, 7 oz. water, 5.3 oz. sulphuric acid required; temperature, 58° F.; insects: mealy bugs, "green fly"; plants: agaves, cacti, cinerarias, pereskia, begonias, mahernias, asparagus, vincas, calceolarias, doryanthes, ferns, oxalis, acacias, cyclamen, clematis, etc.

Results.—In the morning there was a stronger odor than usual in the house. The "green fly" were killed. Of 10 mealy bugs examined 6 were dead, the larger ones being the ones alive, as a rule. The only injury to plants was on the marguerites: a part of the blossom buds were burned just below the bud, causing the buds to droop.

TRIAL XVII.

Conditions.—Date, March 2, 1899; place, second octagon room; 1 oz. cyanide to each 3,000 cu. ft.; left in all night; 8.5 oz. cyanide, 17 oz. water, and 13 oz. sulphuric acid used; temperature, 57° F.; insects: "green fly" and mealy bug. It was found that a large number of mealy bugs had been destroyed by the fumigation of February 15, 16, and 17, but some remained.

Results.—"Green fly" all killed. Of 10 mealy bugs examined 7 were dead. It is possible that a part of this number remained on the plant, dead from the previous fumigation. The younger ones were the ones generally killed. The roses and solanum were injured as usual.

TRIAL XVIII.

Conditions.—Date, March 2, 1899; place, first octagon; 1 oz. cyanide to each 3,000 cu. ft.; left in all night; 9.5 oz. cyanide, 19 oz. water, and 14.2 oz. sulphuric acid required; temperature, 53° F.; insects: mealy bugs; plants: palms, veronicas, cytisus in bloom, oxalis, asparagus, cyperus, ficus, oranges, mahernia, vincas, cupheas, *Spiræa japonica*, marantas, etc.

Number.	House.	Date.	Time.	Temperature.	Condition.	Space.
			Min.	° *F.*		*Cubic feet.*
Trial I	Cactus room	Nov. 9	30	60	Raining	7,076.25
	Stove room		30	60	do	7,357.31
Trial II	Propagating greenhouse	Nov. 16	30		Daylight	22,729
Experiment 1	Glass box	Nov. 27	30	63	Sunlight	42
Experiment 2	do	do	25	55	Darkness	42
Experiment 3	do	Nov. 28	20	47	do	42
Experiment 4	do	Nov. 29	20		do	42
Experiment 5	do	do	25	47	do	42
Experiment 6	do	do	25	45	do	42
Experiment 7	do		30			42
Trial III	Rose room	Nov. 27	25	63	Darkness	4,894.37
Trial IV	Octagon	Nov. 29	30	60	do	25,689
Trial V	Camellia	Dec. 4	30		do	6,196
Trial VI	do	do	30	55-60	do	6,196

Number.	Rate, 1 ounce to—	Potash cyanide.	Water.	Acid.	Results.
	Feet.	*Ounces.*	*Ounces.*	*Ounces.*	
Trial I		[1]40	40	70	Insects killed; no injury to plants.
		40	40	70	Do.
Trial II	285	80	80	120	Plants injured; insects killed.
		Grams.	*C. c.*	*C. c.*	
Experiment 1	570	2.1	2.1	2.1	Insects mostly dead; all plants injured.
Experiment 2	285	4.2	4.2	4.2	Insects killed; no injury to plants.
Experiment 3	190	6.3	6.3	6.3	All but beetles killed; no injury to plants.
Experiment 4	190	6.3	6.3	6.3	Do.
Experiment 5	190	6.3	6.3	6.3	Do.
Experiment 6	142	8.4	8.4	8.4	All insects and some beetles killed; plants uninjured.
Experiment 7	190	6.3	12.6	9.45	
		Ounces.	*Ounces.*	*Ounces.*	
Trial III	570	86.3	86.3	152	Tender buds injured; insects killed.
Trial IV	175	147	147	147	Satisfactory.
Trial V	190	34	68	34	Not wholly satisfactory.
Trial VI	190	37	68	51	Satisfactory.

[1] 98 to 99 per cent pure.

SCALE INSECTS ON AMERICAN FRUIT IMPORTED INTO GERMANY.

[Abstract of a paper by Dr. L. Reh.[1]]

INTRODUCTION.

Extensive scientific investigations could not be made during the first winter of the existence of the station, and the present publication is confined to some statistical notes based upon a careful count of the scale insects found on American fruits. As a matter of course, only a small fraction of the inspected fruits could be made the basis of the following enumeration:

I. INVESTIGATIONS.

DISTRIBUTION OF COCCIDS ON THE SURFACE OF FRUITS.

As a general rule Coccids are found on the protected places of the surface of fruits; in stone fruits, therefore, in the stem cavity, but also on the stem; in pears and apples the flower cavity and the calyx cavity are favorite living places; in apples, in addition, the deep stem cavity. *Aspidiotus perniciosus* alone occurs frequently on the unprotected surface of pears.

I have counted on pears:

	Male.	Female.
Chionaspis furfurus Fitch:		
In the calyx cavity		1
In the flower cavity	1	16
Near the flower cavity		30
On the side		1
Around the stem	10	13
On the stem	1	4
Total	12	65

Similar tables follow regarding 6 other species, which it is not necessary to print in detail, but which may be summarized as follows:

Aspidiotus ancylus Putn., 259 specimens.
Aspidiotus forbesi Johns., 17 specimens, all in the cavity of the flower.
Aspidiotus perniciosus Comst., 757 specimens.
Aspidiotus camelliæ Signoret, 115 specimens.
Chionaspis furfurus Fitch, 52 specimens.
Mytilaspis pomorum Bouche, 59 specimens.

This last-mentioned species proved to be quite aberrant. On the free surface there were 20.34 per cent of the specimens and none whatever in the flower cavity, which is so favored by the other Coccids.

[1] This paper of Dr. Reh's, entitled "Untersuchungen an Amerikanischen Obst-Schildlausen," was published recently in the "Mittheilungen aus dem Naturhistorischen Museum," Volume XVI, and as it summarizes a lengthy series of careful observations, points a moral to American exporters of fruit, and shows plainly the importance to our entire fruit industry of sending abroad only perfectly clean fruit, this abstract in English has been drawn up at my request by Mr. E. A. Schwarz.—L. O. H.

In the following table are summarized the data concerning place on surface of fruits where the specimens were found:

	Above.	On side.	Below.
	Per cent.	*Per cent.*	*Per cent.*
Aspidiotus ancylus	7.33	0.38	92.28
forbesi			100
perniciosus	34.75	3.56	61.69
camelliæ	78.26		21.74
Chionaspis furfurus	13.80	8.62	77.58
Mytilaspis pomorum	71.18	20.34	8.48

From a consideration of these figures I am inclined to assert that the distribution of scale insects on the surface of fruits depends on the sensitiveness of the insects to meteorological influences. Those not sensitive are *Aspidiotus camelliæ*, and especially *Mytilaspis pomorum;* those very sensitive are *Aspidiotus ancylus* and *A. forbesi; Aspidiotus perniciosus* is comparatively not sensitive.

STAGE AND SEX OF THE SCALE INSECTS (COUNTED ON FRUIT).

Free living larvæ have never been found, and the specimens designated as larvæ are specimens already fixed.

A. ancylus.—Among 262 specimens were 250 immature females, 12 larvæ. There is therefore hardly any danger that this species could be imported, although it is by far the most common species.

A. forbesi.—Of the 17 specimens all were immature females, but in a few instances (not enumerated here) a few male larvæ were seen. On account of the rarity and sensitiveness of this species there seems to be no danger of its being imported.

A. perniciosus.—I counted 82 males, 354 females, 259 larvæ. The specimens designated as males were, almost without exception, male larvæ or male pupæ. Most of the females were almost mature and many had eggs, but only 2 had mature embryos. The danger of importation of this species is therefore very great. In sendings of apples (pears are sent to Germany only in a dried condition) which arrive in the late fall of the year this danger is reduced to a minimum, but it increases with the beginning of spring, reaching its maximum from March to May.

A. camelliæ.—Of 33 specimens 1 was a male (dead), 10 females with mature embryos, 12 females mature but without embryos, 9 young females, and 1 larva. There is danger in its importation, since it occurs only in warmer countries and since its home is southern Europe.

Chionaspis furfurus.—Of 133 specimens 115 were females, 17 more or less developed males, and 1 larva. Of the females 94 were filled with eggs. The danger of the importation of this species appears to be quite considerable, but is reduced by the facts that the species is confined to warmer countries and that it is everywhere driven out by *M. pomorum*, which is so common in Germany.

Mytilaspis pomorum.—Of 63 specimens all were females. Of these 14 were examined, and 11 of this number contained eggs. Since this species is a native of Europe, the question of importation can hardly be considered.

In summing up, a danger of importation comes into consideration only with the San Jose scale, and the recent edicts of the Government are therefore justly confined to this species.

LIVING AND DEAD SPECIMENS AMONG IMPORTED SCALES—PARASITES.

For dried fruits of all sorts it must be accepted as an invariable rule that no living scale has ever been found thereon. The following tables refer to fresh fruit, and while, as Professor Kraepelin says, the colonization of such fruit by scales must be considered as an abnormal phenomenon or an aberration, there is no reason to doubt that such scales as have settled on fruit will develop and propagate.

Aspidiotus ancylus.—Of 250 females 232 were alive; of 12 larvæ 11 were alive; total, 92.75 per cent alive, 7.25 per cent dead. Of the 19 dead scales 4 had been killed by hymenopterous parasites and 2 were infested by fungi.

A. forbesi.—Of 17 females 1 was dead.

A. perniciosus.—There was considerable difference in the various lots and the following tables are taken at random from those I have examined, in some of them the scales being greatly and in others poorly infested by parasites.

Here follow six tables which it will not be necessary to print in full, the summary of which is as follows: Two hundred and fourteen (33.49 per cent) living and 425 (66.51 per cent) dead specimens of *A. perniciosus* were found. Of the dead specimens 63 were "eaten out" (killed by insect enemies), equal to 9.06 per cent of all specimens, and 156 (equal to 22.44 per cent of all specimens) were infected by fungi.

More than 30 per cent of all imported San Jose scales arrive infested by parasites (insects and fungi). The experiments regarding the acclimatization of hymenopterous parasites seem to be beset with great difficulty. That of the fungi would be easier, and it would be quite important to ascertain whether the fungus found by us is really *Sphærostilbe coccophila.* This question must be left to the botanists.

COMMON OCCURRENCE OF SEVERAL SPECIES OF COCCIDÆ.

1. *Common occurrence on different apples of the same sending.*—*A. ancylus, A. forbesi,* and *M. pomorum* on Russets (November 21, 1898).

A. ancylus and *M. pomorum* on Baldwins three times (November 25, 1898, December 14, 1898, December 27, 1898); on Canada Red (November 28, 1898), on Rock Russet (December 14, 1898), and on Spy (November 25, 1898).

A. ancylus and *Ch. furfurus* on Fallawater (November 22, 1898).

A. camelliæ and *M. pomorum* on Newtown Pippins (December 29, 1898).

A. perniciosus, A. camelliæ, and *M. pomorum* on Newtown Pippins (November 14, 1898).

A. perniciosus, *A. forbesi*, and *Ch. furfurus* on Ben Davis, from Virginia (December 6, 1898).

2. *Common occurrence on one apple.*—*A. ancylus* and *A. forbesi* on one English Russet (November 29, 1898).

A. camelliæ and *M. pomorum* on one Newtown Pippin (February 14, 1899).

A. perniciosus and *A. camelliæ* on two Newtown Pippins (February 14, 1899).

A. perniciosus and *M. pomorum* on one Newtown Pippin (February 14, 1899).

The result of the investigation is rather negative. The various species of Coccids occur in company in all sorts of combinations, but it seems that the occurrence of *A. ancylus* excludes that of *A. camelliæ* and *A. perniciosus*.

EXPERIMENTS.

No experiments to imitate the American methods of drying fruit were made for various reasons, but more especially because we rely implicitly upon the results of the experiments made in the laboratories of the United States Department of Agriculture, under the direction of L. O. Howard, by the pomologist, William A. Taylor, and the entomologist, Nathan Banks.

Only the two following experiments appeared to me important in relation to the importation of fruit:

1. The non-importation edict is also directed against the wrappings and packings of the invoices. Many wrapping papers were examined by us, but always with negative result. In this connection experiments were made to ascertain how long a Coccid would live when removed from its place and transported to another place on the apple. The result was that, under the most favorable circumstances, the Coccid lives about three months; under ordinary circumstances, about one week.

The result is that the various packings—barrels, boxes, paper—do not appear to present any danger as to the transportation of the San Jose scale.

2. The non-importation edict refers also to dried-apple peelings. Upon such peelings no living Coccids have ever been found, as far as I know, but I made experiments to ascertain the vitality of *A. perniciosus* on fresh peelings. Result: The scales on the thickest peelings lived longest, not quite twenty days; on ordinary peelings they died in from eight to fourteen days. But in all cases these peelings were fresher than those arriving from America.

A few other experiments may be briefly mentioned here.

3. *Re-formation of the scale, and vitality without the scale.*—The scale was carefully removed from the Coccids without touching the latter, but a re-formation of the scale never took place. If the scale was only slightly lifted it was slowly but firmly drawn back again by the insect. The vitality without scale was a very long one, extending over more than three months.

4. The behavior of Coccids on rotten apples appears to me of importance, because such apples are of course thrown away. My experiments

gave the result that Coccids are able to retain their vitality on rotten apples for about three weeks.

5. *Vitality of Coccids immersed in water.*—The few experiments seem to show that Coccids can live several hours under water.

6. *Experiments with gases.*—Cold vapor of alcohol does not kill; warm vapor of alcohol kills pretty quickly. Vapors, cold and warm, of formalin do not kill. Sulphur vapors seem to kill scales on apple. Common chloroform gas easily kills the lice, but the apples turn quite brown. To gas of cyancalium the lice proved to be quite indifferent.

7. *Fluids that penetrate the scale.*—Quickly evaporating fluids—such as alcohol, formalin, chloroform, eau de Javelle—do not seem to have any effect, whereas a painting of the scale with sulphuric acid, toluol, and heavy oil (Rüböl) surely killed the lice.

8. *Temperature experiments.*—One apple was immersed for twenty minutes in water of 50° C.; the lice were not killed.

Without microscopic examination of the cells it is extremely difficult to decide whether a Coccid is dead or alive.

INSECT CONTROL IN RIVERSIDE, CALIFORNIA.

By Felix G. Havens, *Riverside, Cal.*

The work of insect pest control naturally divides itself into three parts, viz, inspection, eradication, and quarantine.

INSPECTION.

In Riverside County the work of inspection is organized as follows: The county board of horticultural commissioners, consisting of three members, has divided the county into three divisions, each division being in charge of one commissioner. The orange-growing section, known as Riverside, and comprising 12,500 acres of citrus orchards, is one of these divisions. Riverside division is subdivided into six districts, and a local inspector is in charge of each district.

All of the work of inspecting done in each district is reported by the inspector in charge, and these reports give in detail the names of the inspectors employed, owners of property inspected, acres examined, pests found, date of plat or report, amount of time occupied in inspecting each ranch, and how divided as between the inspectors employed.

Each orchard is examined tree by tree and row by row, together with all of the shrubbery, rosebushes, etc., on the place. Whenever infested trees are found in an orchard they are marked around the trunk or in some equally permanent manner, and the inspector in charge notes their location in the orchard, and when the orchard is finished, he makes a plat or diagram showing the location of all the infested trees in the orchard, in relation to each other and to the boundaries of the orchard. The orchards are so set out and arranged that a sheet crosslined with 35 lines each way can be used to correctly designate the location of each

tree on any given 10 acre orchard in the county. Where orchards are less than 10 acres the diagram is cut down, and where more than 10 acres it is platted in 10-acre sections. Three copies of all plats are made, and used as follows: One is given to the foreman of the eradication work and is used in locating the trees in the orchard when that work is done, one copy is filed in the office of the horticultural commissioner, and one is given to the owner of the orchard.

The inspector keeps the notes taken at the time the infested tree was found and thus has a permanent record. By these means the identification of all infested trees is made absolutely correct. The plats of each orchard for the consecutive years or inspections are kept together and present in each case a full brief of the course of the insects in each orchard. The work of inspection is at present being fully cared for in the entire 12,500 acres by six inspectors. The older part of the orchards, comprising about 5,000 acres, is inspected as near as may be once a year. It is in these orchards that the pests were established when the inspection began, and as most of the trees are large seedling orange trees, from twenty to twenty-five years old and 30 feet high by 20 feet in spread of branches, it can be seen that an inspector must needs be expert to safely inspect from 2 to 3 acres of such trees per day. The younger part of the orchards comprises about 7,500 acres, and contains mostly navel orange trees. These trees have all been set out since the horticultural commission was established, and as every tree was inspected and none allowed set out unless it was clean of insect pests these orchards have grown up under good care and not to exceed 20 trees infested with pests have ever been found in the whole 7,500 acres. An attempt is made to inspect this part of the orchards once in two years. The work has always been such that the efficiency of the inspection was of the highest importance. In case of such pests as the red scale, for instance, if an inspector should fail to find it on a tree, before the routine brought the inspector around to the orchard again not only would that tree be badly infested, but a dozen trees or more perhaps in its immediate vicinity would be affected also. The policy has been to use every endeavor to stamp the pests out, and to that end every tree found infected has been treated. If the infection was slight and only on a few leaves or one or two twigs, the branches were cut out liberally and burned. This was found to be quite sufficient in almost all of such cases, and thousands of trees have been cleaned in this way by the inspectors, and have never since shown infestation. By this system of reports, records, plats, etc., it is possible to keep track of every tree in all this 12,500 acres and find all of the data in our office, and all arranged in very simple manner. A tree selected at random anywhere in this valley can be taken, and the records of the commission will show whether it was ever found infested with pests, and what kind, also how many times, and the dates when it was inspected, name of the inspector who examined it each time, and if it has been found affected with pests when it was treated and what with, also what variety of fruit the tree is.

This does not involve a complex system at all, for a few very simple reports and plats furnish it all. The cost of this system of inspection since April, 1895, and the acres examined, number of trees found infested each year to date in Riverside division, has been as follows:

Period.	Cost of inspection.	Acres inspected.	Trees found infested.
1895, 9 months, April to December 31	$4,964.97	4,523	8,375
1896	3,936.19	4,678	7,580
1897	3,503.31	4,125	6,670
1898	4,015.04	4,680	5,888
1899, 11 months, to December 1	3,734.68	4,980	1,637

In this State fruit trees over 4 years old are taxed. In this county an agreement has been made whereby the money raised from this tax is available for the work of the horticultural commission. It is divided between the three divisions, each division receiving the money raised by the tax on the trees within its limits.

Under this arrangement Riverside has never used her full share of the money in any year since 1894.

The expense given in the above table covers also the cost of the quarantine work; in fact, all of the expense of the Riverside division except the work of eradication.

The following is the form of report each inspector makes covering operations in his district:

Report of fruit pest inspecting done and time of each inspector working in ——— division ———, district during ———.

———— ————, Inspector in Charge. ———— ———— Assistants.

Name of owner.	Day of month.	Kind of trees, ———. Acres examined.	Kind of trees, ———. Number infested.	Kind of pests.	Inspector, ———.	Inspector, ———.	Inspector, ———.	Inspector, ———.	Inspector, ———.	Total amount of time spent in inspecting ranch.	Date of return of plat of ranch.	Remarks.
					Days.	*Days.*	*Days.*	*Days.*	*Days.*			

ERADICATION.

Efficient methods for destroying insect pests are fully as important as careful work in inspection. The pest which has given the most trouble is the red scale; other scale pests have either never gotten a foothold or else have been checked by parasites or natural causes. The hydrocyanic-acid gas treatment is the one that has been generally used on citrus trees, and it has been almost uniformly successful.

Previous to June, 1897, the work of eradication was under the control of persons not connected with the horticultural commission, and, consequently, there was not the system and promptness so essential in work of this kind. The new horticultural law, which took effect April, 1897, provided that owners or agents of pest-infested trees or premises be given notice as follows:

NOTICE.

No. ——.

To —— ——, residence ——.

You are hereby notified that the undersigned, horticultural commissioner of the county of Riverside, State of California, has caused an inspection to be made of your orchard and the trees thereon, located at ——, in said county.

That said examination was made on the —— day of ——, 189—, and that upon said examination of your said orchard —— trees were found to be infested with —— injurious to fruit and fruit trees. You are therefore notified that your said orchard and trees are infested with said —— injurious to fruit and fruit trees, and you are hereby required to eradicate or destroy the said scale insects and other pests and their eggs and larvæ, within —— days of the time of the service on you of this notice.

Dated this —— day of ——, 189—.

—— ——,

Horticultural commissioner as aforesaid, quarantine guardian in and for the county of Riverside at large.

Notice served by —— ——, horticultural inspector.

The law further provides that in case said owners, etc., do not eradicate the pests, it is the duty of the horticultural commissioners to at once proceed to abate and eradicate said pests. This made it necessary for the horticultural commissioners to be provided with the required outfit for the business. The commissioners therefore had the following form of contract prepared, secured the signature of the owners of infested property, and went into the fumigating business.

FORM OF CONTRACT.

STATE OF CALIFORNIA, *County of Riverside, ss:*

I hereby waive the within notice, and all notice and service thereof, and consent that the horticultural commissioner may proceed at once without further notice or any notice and eradicate and destroy the scale insects and other pests and their eggs and larvæ with which my orchard and trees are infested, at my expense.

—— ——.

——, 189—.

The work is done at actual cost, but 10 per cent is added to cover repairs and to replace the outfit when it wears out.

Below is given the cost and number of trees fumigated since June 7, 1897:

Year.	Number of trees.	Total cost.
1897	4,720	$4,153.60
1898	5,888	5,299.20
1899	1,637	1,474.87

An examination of the above figures discloses a phenomenal decrease in the number of pests since 1898. A comparison of records shows that 28 orchards of a total acreage of 345 acres had 1,609 trees found infested with red scale and fumigated in 1898. The same orchards at the 1899 inspection turned out only 433 infested trees. Also 38 orchards, containing 460 acres, had 2,134 infested trees in 1898 and 633 in 1899. In all of these 3,734 trees fumigated in these 66 orchards containing 805 acres, not a single one but was cleaned and the pests destroyed by the fumigation of 1898. Every one of the 1,066 trees found this year were new ones that had never shown infection before.

These orchards referred to are in the oldest section of the Riverside orange district, and the trees, which are seedlings, are mostly over twenty-five years old, and the red scale was established in them when the horticultural commission was established in 1889. The records of the commission show this to be the smallest number of infested trees ever found at any inspection of these groves since the records began, which was April, 1895.

QUARANTINE.

The quarantine work is regarded as the most efficient part of the service. The pests kept out do no harm. In this part of the work is included the inspection of all nursery stock grown in the district and the inspection and treatment of all nursery stock and fruit brought in; also the inspection of fruit-packing houses, and attention to all of the methods whereby pests might be carried from one locality to another orchard or locality. So efficient has this work been that no insect pests have been brought into Riverside and become established since the horticultural commission was established; and this, too, in the face of the fact that in 1890, 1891, and 1892 more than 200 carloads of orange nursery stock was brought to this place from Florida and set out.

A very large proportion of the navel orange orchards was planted with this stock. There was hardly a tree among all of the hundreds of thousands that was not infested with dangerous pests, and many of them were covered with purple scale. The worst infested trees were burned, and the rest dipped in a strong whale-oil soap and kerosene solution and the insects scrubbed off with stiff bristle brushes.

A tree was never allowed to be taken away as long as there was any possibility of there being pests on it. Similar vigilance has been observed ever since, and the results have more than justified the carefulness of the commission. The law requires all persons bringing in or receiving nursery stock to notify the horticultural commissioner or local inspector within twenty-four hours of the time of their arrival.

The railway and express agents also refuse to deliver such goods except to the horticultural officers.

All shipments of nursery goods are inspected before delivery to the owners, no matter whose certificate accompanies them, for experience has amply convinced the commission that it can not afford to take any

chances whatever, but must be governed by the condition of the nursery stock in every case. In innumerable cases the accompanying certificate gave the stock a clean bill of health, when a careful examination would reveal the presence of dangerous pests. Sometimes it would be root borers, as in the case of Japanese orange stock, which passed the State quarantine officer's hands. The commission regards it as a matter of the utmost importance that the inspection of nursery stock should by all means be done at destination of goods, no matter where else they may have been examined. In no other way can the matter be brought home to every community and made a local one, which it is in a very large measure.

In addition to the nursery stock work, both that coming in and that being shipped out, the fruit-packing houses are watched and all infested fruit condemned and destroyed; also the orchard it came from is traced and inspected and the infested trees fumigated as soon as possible. The fruit packers are not allowed to take boxes, ladders, etc., from infested groves to those known to be free of pests. In these matters the commission has the hearty cooperation of both packers and growers.

CONCLUSION.

The system has grown up with the magnitude of the work. Changes and improvements have been made by each of the commissioners who have had it in charge. The law has been changed in some respects; public opinion, which has always been strongly in favor of the work, is now unanimously for it; the courts have lately upheld the law, and the commission looks forward in expectation that Riverside will continue to be, as it now is, not only the largest compact area of citrus groves in the world, but the cleanest of insect pests as well.

NOTES ON A BRIEF TRIP TO PUERTO RICO IN JANUARY AND FEBRUARY, 1899.

By A. Busck, *Assistant.*

Sir: December 11, 1898, in accordance with your instructions of December 10, 1898, I proceeded to Norfolk, Va., and joined the United States Fish Commission expedition on the U. S. S. *Fish Hawk* for Puerto Rico. My instructions read as follows: (1) "Make as complete a collection as possible of the scale insects of the island, making an especial effort to secure their parasites; (2) to collect and learn as much as possible about other insects in all orders, especially those injurious to agriculture."

The results of the trip were the collection of between 800 and 900 species of insects, together with many spiders and myriapods, most of which have already been determined. It is the object of the writer, however, in this brief report to give simply a summary account of the journey, with mention of such injurious insects as he could collect or learn about. He has appended a list of Coccidæ which he collected and which have been named by Messrs. Pergande and Cockerell.

Stopping on the way at Charleston, S. C., Tybee Island, Georgia, and Nassau, Bahama Islands, I used the limited time at each place to collect. I arrived at San Juan, P. R., January 2, 1899, and worked from there on the northern part of the island as far inland as Caguas and Bayamon. January 17 the *Fish Hawk* took me to Aguadilla, on the northwest corner of the island, and leaving the steamer I worked on foot and by rail south to Mayaguez and, after a few days, north and west inland on horseback over Anasca, San Sebastian, Lares, Utuado, and south to Adjunctas and Ponce, stopping at each place a few days. From Ponce I again took the *Fish Hawk*, February 2, to Arroyo, in the southeast corner of the island. After a few days' work from this point inland as far as Guayama I remained on the steamer on its coaling trip to Saint Thomas, Danish West Indies, and stopped on the way back several days on the two American islands, Viegues and Culebra. I landed February 13 on the east coast of Puerto Rico and worked over Humacao, Fajardo, El Yunque, and Carolina back to San Juan and joined the steamer there for the home trip, February 22, via Key West, reaching Norfolk, Va., March 8, and Washington, D. C., the next morning.

Of insects injurious to the sugar cane in the field were especially noted the common lepidopterous borer in the stalk, *Diatræa saccharalis; Sphenophorus sexguttatus* Drury, also boring in the stalks; a lamellicorn larva common and destructive to the roots, and a mealy bug, *Dactylopius sacchari* Ckll. The first of these was in some localities quite bad, nearly every cane containing several specimens, but no intentional remedy is undertaken. The annual cutting and crushing the cane with all living larvæ and pupæ naturally keeps the pest in check, but the remaining roots and single canes always contain enough individuals to infest the next year's growth.

The coffee plantations seemed remarkably free from serious insect pests. Of scale insects only *Lecanium hemisphæricum* was found, and that very sparingly, and mostly killed by a parasitic fungus. The coffee leaf-miner, *Leucoptera* (*Cemiostoma*) *coffeella*, was very abundant, the empty larval mines being often found three or four on nearly every leaf, giving the trees a brown, withered aspect; but this did not seem to injure the trees seriously, at least no attention was paid to the insects by the growers. I was told several times about depredations of a snout beetle, which at times does so much damage to "the leaves, young shoots, flowers, and berries" as to kill the trees, and estate holders pay a premium for each bushel collected and destroyed, but during the dry season, when I was there, neither beetle nor damage was visible.

In the tobacco fields, among other insects met with, were the tobacco Sphinx, *Protoparce carolina*, both in larval and adult stage, and the tobacco "split worm," *Gelechia solanella*,[1] which are also tobacco enemies in the United States.

[1] Not hitherto recorded from the West Indies.

Here I met with the only trace of applied economic entomology that I found on the island; it was directed against the very abundant and very destructive "shanga," a mole cricket, *Gryllotalpa hexadactyla* (named for me by Dr. Stahl in Bayamon, who told me that it is a comparatively new insect in Puerto Rico, having been introduced within his recollection). This insect is one of the first which draws the attention of an entomologist, first, on account of its size and abundance, and because it flies to light, and becomes a nuisance in houses, second, because it seems to be the only insect known to be injurious, in the minds of most people in Puerto Rico. When asked about "insectos," they may mention "Mariposas" and "esperanza," but first and last "el changa," which is invariably pronounced "mucho malo" (colloquial for *muy malo*, very bad). The protection against this insect consists in the use of the large, smooth leaves of "mammee" (*M. americana?*), which are placed one around each plant edgewise, like a cylinder, down about an inch in the ground. I have seen thousands of young plants of tobacco or vegetables thus protected, the leaves being placed around the plants when they are set out in the field from the seed bed. It is a tedious way, but seems to give good results, probably merely as a mechanical fence, which the mole cricket does not dig under or through; in which case cheap tin cylinders 5 inches high and 3½ inches in diameter, made wholesale, would be a practical substitute; it is possible, though, that the mammee leaves may be disagreeable to the insects.

Among the insects injurious to small vegetables *Spartocera fusca* was especially abundant and noxious, sucking the stems of "Malanga" and "Yauchia."

Of shade tree enemies the showy larva of *Pseudosphinx tetrio* was found in all stages, during my visit, on the ornamental "Alelia" (*Plumieria rubra*).

One striking feature in the insect fauna is the abundance of honey bees and no beehives; at least I neither saw nor heard of any, and they must be a rarity. Still the honey harvest is quite important, although the figures given in the last Estadística General del Comercio Exterior, of Puerto Rico ($517,746), of the exportation thereof surely must be wrong, unless they possibly include molasses. Very large colonies of a dark variety of *Apis mellifica* were abundant in hollow trees and especially in caves, sometimes also in outhouses. These are annually smoked out and furnish large quantities of honey.

I was in all fifty days on the island, several of which were necessarily lost in traveling about in order to keep connection with the steamer. Naturally such a short trip in the dry (winter) season, when the real characteristic fauna is dormant, and handicapped by the limited knowledge of the language, customs, roads, and way of traveling, could only result in a mere skimming of information concerning the fauna of the island.

An expedition undertaken in the summer season and with more time, so as to give opportunity for breeding insects, would be very interesting

and would undoubtedly result in the discovery of many new and characteristic species. On such an expedition the investigator should not try to cover the whole island, as was necessary in my case, but should settle down for a month at a time in two or three localities and explore them thoroughly. Bayamon with its very varied surroundings, and near which are found some extensive and interesting caves, would be one profitable stopping place, and has the advantage that tolerable food and quarters can be obtained, and communication with the outside world is easy by rail to San Juan. Adjuntas, on the south side of the mountain range, is another place with the same advantages. The south side of the island is rather more interesting than the north, where the dry and rainy seasons are not so sharply defined.

Very interesting are the two small islands, Culebra and Vieques, and both would give good returns under a prolonged stay.

The only large tract of virgin land is the mountanous northeastern part centering in the almost inaccessible mountain top, El Yunque.

To explore the fauna of this unique locality one should be provided with food supply and tent, and making one of the coffee estates nearby headquarters, should take trips for a few days at a time. Horses are out of the question on such a trip, and guides as such are useless, as none of them have ever been through there; still a native is very helpful to have along, as he will cut you through the thorny luxuriant tropical underbrush with his machete, where you would be absolutely barred without him, or at least his machete.

I found a strong beating net with plenty of extra netting very useful in collecting. Sifting can not be practiced easily because of the extreme humidity of the soil.

During my stay in Puerto Rico I met the most courteous reception from everybody, and my friendly intercourse with many natives of different stations in life was a help to me while there, and a happy recollection now. Particularly am I indebted for identification of plants, and much other valuable information, to the learned Dr. Agustin Stahl, of Bayamon, who is a close observer of nature and has made large collections and very fine colored drawings of life histories of many insects. For most hospitable reception and readily given explanations about agricultural matters, I wish especially to thank Señor Manuel Gonzales, of Hacienda "Casualidad," near Aguadilla; Señor G. Bianchi, "Central Pagua," Anasco; Señor Santiago Pietri, "Esperanza," Adjuntas, and the Mulero family, on Culebra Island.

From the alcaldes in all the towns I visited, as from the American officers stationed there, I received helpful courtesies. But perhaps most highly of all receptions did I prize the unmistakable glad welcome extended to me as an American citizen all over the island by the poorest class of native laborers. They had nothing to give, and it was only meager information of any kind I was able to wrestle from them with my very limited Spanish; but the eagerness to please, the activity with which an entire family would turn out to dig in the ground, turn

stones and logs to procure "insectos" (which mostly showed up to be large spiders and myriapods), or climb the tall trunk of a cocoa palm to offer me a refreshing drink of cocoa milk, made one feel well and at home.

Needless to say that I never carried any weapon for defense, and never had the slightest use for one.

Thanks are due to the U. S. Fish Commission, through whose invitation the trip was made, as well as to the entire expedition under Professor Everman and to the officers and crew of the U. S. S. *Fish Hawk* for the very pleasant and profitable sojourn among them.

All identifications of insects are made through the Division of Entomology.

LIST OF COCCIDÆ COLLECTED BY MR. A. BUSCK IN PUERTO RICO, 1899.

By *T. Pergande* and *T. D. A. Cockerell.*

Only one Coccid (*Aspidiotus destructor*) has been recorded in print from Puerto Rico. (Canad. Entom., 1895, p. 261.) It was collected by Mr. J. D. Hall at San Juan.

Icerya montserratensis Riley and Howard.

On orange, Mayaguez, January 20.

On orange, Bayamon, January 10.

Phenacoccus gossypii Twns. Ckll.

On cotton, Humaçao, February 15. New to the West Indies.

Dactylopius sacchari Ckll.

On sugar cane, Bayamon, January.

On sugar cane, Mayaguez, January.

On sugar cane, Humaçao, February.

Asterolecanium pustulans Ckll.

On some leguminous plant, Guayama, February 4.

On *Anona reticulata*, San Juan, February 21.

Asterolecanium aureum Boisd.

On a fiber plant, San Juan, January 17. Occurs on the leaves.

Asterolecanium bambusæ Boisd.

On bamboo, Bayamon, January 12.

On bamboo, Utuado, January 28.

Pulvinaria sp. on undetermined weed.

Viegues Isle, February 7.

Lecanium oleæ Bern.

On Calabassa tree, Lares, January 25.

On honey-locust, Adjuntas, January 30.

On *Guazuma ulmifolia*, Guayama, February 4.

On *Terminalia catappa*, Mayaguez, January 20. (Brown variety.)

Lecanium nigrum Nietn.

On *Terminalia catappa*, San Juan, January 5.

On cotton, San Juan, January 5 (var. *depressum* Targ.).

Lecanium hemisphæricum Targ.

On eggplant, Catana, January 17.

On guambana, San Juan, January 5.

On coffee, Caguas, January 10.

Ceroplastes floridensis Comst.

On *Anona reticulata*.

Vinsonia stellifera Westw.

On cocoanut palm, Catana, January 16.

On cocoanut palm, Bayamon, January 16.

On cocoanut palm, Arroyo, February 3.

Diaspis pentagona Targ.—*amygdali*, Tryon.
On castor-oil plant, Rio Pedro, January 17.
On unknown tree, Bayamon, January 16.
On peach, Adjunctas, January 24.
On honey-locust, January 30.
On mahagua, Fajardo, February 17.
Diaspis calyptroides Costa, var *opuntiæ*, Ckll.
Ponce, February 1.
Chionaspis citri Comst.
On lime, Anasco, January 20.
Chionaspis (*Hemichionaspis*) *minor* Mask.
On eggplant, Catana, January 17.
On *Guazuma ulmifolia*, Guayama, February 4.
Ischnaspis longirostris Sign.
On cocoanut palm, Caguas, January 11; Catania, January 12; Mayaguez, January 20; Arroyo, February 3.
Howardia biclavis Comst.
On *Bixa orellana*, San Sebastian, January 24; Anasco, January 20.
This and the following five species were studied also by Mr. C. L. Marlatt.
Chrysomphalus aonidum Linn.—*ficus* Ashm.
On *Terminalia catappa*, San Juan, January 5.
On *Anona muricata*, San Juan, January 5.
On oleander, Ponce, February 1.
On *Musa*, Caguas. (Some of this lot had the exuviæ very dark, black or nearly so.)
Aspidiotus aurantii Mask.
On *Anona muricata*, San Juan, January 5.
On *Anona muricata*, Ponce, February 3.
Aspidiotus articulatus Morgan.
On orange leaves, El Yunque, February 18; about 2,000 feet altitude.
Aspidiotus personatus Comst.
On plantain leaves, Caguas, January 11.
On *Anona muricata*, San Juan, January 5.
On banana leaves, Catana, February 21.
On cocoanut palm, Mayaguez, January 20; Caguas, January 11.
Aspidiotus destructor Sign.
On banana leaves, Catana, February 21.
On banana leaves, San Juan, January 5.
On banana leaves, Arroyo, February 3.

GENERAL NOTES.

A DIPTEROUS ENEMY OF CUCURBITS IN THE HAWAIIAN ISLANDS.

March 13, 1899, we received from Mr. George Compere, Honolulu, Hawaiian Islands, specimens of what is locally known as the melon or cucumber fly. Our correspondent, writing under date of February 14, 1899, states that this is a very serious pest with vegetable growers, as it destroys more than 75 per cent of the watermelons, cantaloupes, and cucumbers grown in those islands. He writes, in substance, that the parent flies are to be found at all seasons of the year, and that they puncture the cucumber, which is the only plant on which our correspondent has observed the species, on the upper side, and generally near the stem end, this operation taking place when the cucumber is about half or two-thirds grown. In the punctures thus made they deposit

their eggs, which soon hatch into minute footless white maggots. Their presence in the cucumber is manifested by a small yellow spot where the puncture was made. Twenty-seven minute maggots were counted in one of these punctures. In one cucumber that had been punctured three times in different places 116 of these maggots were counted. These maggots eat out the entire inner substance of the fruit with the exception of the seeds, leaving only the outer skin, which turns yellow and decays, when a slight touch or a few drops of rain will cause it to collapse. By that time the maggots have all attained their growth, and if any of them become exposed to the sunlight they immediately draw themselves together and, after the manner of the cheese maggot and other species that might be mentioned, spring in all directions, jumping as high as 3 feet. If the skin of the cucumber be left intact they will emerge from the decayed pulp on the underside and burrow at once into the earth for pupation. Fourteen days after placing maggots in a breeding jar, with soil kept constantly moist, Mr. Compere succeeded in obtaining the adult flies.

In the conclusion of this letter our correspondent adds, as a warning, that watermelons, canteloupes, and cucumbers should never be allowed to be shipped from the Hawaiian Islands into the United States. It is quite probable that this insect could be introduced into several of our Southern States or recently acquired insular possessions, and it is one of those species for which quarantine inspectors should be on the lookout. No class of vegetables, if we except cabbages and botanically related plants, are so badly infested with insects as are the cucurbits, and the introduction of another new pest is most undesirable.

The insects were referred to Mr. Coquillett, of this office, who after careful examination pronounced the species an undescribed Trypetid. He has accordingly given it the name of *Dacus cucurbitæ*, and has published a description of it in Entomological News for May, 1899, under the title "A New Trypetid from Hawaii."

A TROUBLESOME TWIG GIRDLER OF THE SOUTHWEST.

October 23, 1899, we received from Mr. Morgan R. Wise, Calabasas, Ariz., specimens of the twigs of mesquite (*Prosopis juliflora*) girdled by the long-horned beetle (*Oncideres putator*), together with the statement that this very valuable tree is much injured by the girdler. The previous year the beetles had done much injury, so that this year the girdled twigs snapped off dead. Our correspondent was of the opinion that if this condition of affairs continued that ultimately the mesquite tree would be exterminated by being so badly crippled as to preclude the possibility of its bearing fruit.

Mr. Schwarz, of this division, who has traveled very extensively through that portion of the Southwest, states that this beetle is extremely injurious to the mesquite, particularly in western Texas, southern New Mexico, and in Arizona. In certain localities which he visited all of the young shoots of bushes were girdled, which has the

ultimate effect of amputation; but old trees never suffer much. The trouble he believes to be due to the frequent cutting down of old trees, as this in a measure compels the beetles to attack the young growth for food for their young.

This species, as its scientific name indicates, is a near relative of the common hickory twig girdler (*Oncideres cingulata* Say) of the Eastern States, accounts of which have been published in most text-books on economic entomology and which is treated in the Fifth Report of the United States Entomological Commission, on pages 288–290. The manner of working of the two species is probably very similar The beetles of both occur in August and until October. If the injured branches were systematically collected and burned in the winter or before the appearance of the adults in August, future damage could be greatly lessened, particularly if these measures were practiced over a considerable territory.

NOTES ON COCKROACHES IN SOUTH AUSTRALIA.

In regard to Mr. Marlatt's chapter on cockroaches, I beg to remark that my observations on our native ones lead me to slightly different views as to their general habits. Thus, I have never yet seen a Blattarian eat a living plant in nature, but frequently found them devouring caterpillars, other soft-bodied insects. etc. Plants injured where they abound I have always found to have been attacked by snails, caterpillars, etc. In my garden *Epilampra notabilis* occurs in numbers at certain times, and with its multiplication the herbivorous larvæ disappear rapidly, and I have always spared the lives of such forms as species of Polyrasteria and Platyrasteria which might be taken home alive with firewood and placed among the boxes, timber, etc., of my outhouse. yet have never observed any increase; nay, they remain very few. Still, I suffer very much less than others from depredations of the notorious household insects. Even centipedes and spiders are protected without the slightest bad results, but instead there is freedom from any excessive insect injuries. I regard the Blattariæ as eminently carnivorous, of which a few species (the domestic ones) have developed a capacity for amylacious food assimilation. Although *Periplaneta orientalis* and *americana* were very troublesome some years ago, there are scarcely any complaints received now, though they are by no means extinct; and this, I think, is in consequence of the application of a very simple remedy which I have recommended in every case, viz, a mixture of plaster of paris (1 part) and flour (3 to 4 parts) in a saucer, and near by another flat plate with pure water, both supplied with several bridges to give easy access, and one or two thin boards floating on the water, touching the margin. The insects readily eat the mixture, become thirsty and drink, when the plaster sets and clogs the intestines. The insects disappear in a few weeks, the bodies no doubt eaten by the survivors. Where a few of the large kinds occur, the small ones disappear quickly, and it took a long time before I could secure a sample of

Phyllodromia germanica (last year only). I have seen and captured large and small kinds in my own house, but they never increase beyond a few stray ones and give me trouble. The only kind of pyrethrum powder I found effective is Keating's; the others only seem to intoxicate, but not to kill. Neither fleas, bedbugs, ants, nor moquitoes appear to be proof against its effects nor the minute pests infesting dried plants.—J. G. O. TEPPER, Adelaide, South Australia.

INSECTIVOROUS HABITS OF LIZARDS.

Our prettiest lizards are the most useful ones. Our three kinds of horned toads are great eaters. I have never known one to eat anything but live, moving insects.

While the garden toad feeds mostly by night, the lizards feed by day and bury themselves at night, both as a protection from nocturnal enemies and to absorb moisture from the earth. Contrary to general report, they do sometimes drink. I have seen pet lizards do so. A large horned toad will kill a small snake, probably because the snake would eat its young ones. The young—sometimes more than a dozen—are born, each inclosed in a skin covering (some call it an egg). In an hour or so this skin cracks and the young emerge looking just like their mother and begin at once to eat minute insects that are so small that they would not be noticed if one were not looking for them. I have seen them eat bedbugs when a few weeks old. Our several kinds of blue-tailed lizards eat the most minute insects as well as worms so large that they have to bite them off in mouthfuls. They dig about the roots of plants with their tiny hand-like forefeet and bring out something that makes a noise when they crush it, whether eggs of insects or hard-shelled insects I could not tell. Like the horned toad, they are fly-catchers, ant-eaters, and worm-eaters. It is often said that "blue-tailed lizards are spitters and ought to be killed;" that "horned toads are as poisonous as rattlesnakes;" that "the bite of a horned toad makes a sore that will not heal." When I see the persecution that these harmless animals suffer, I wish that they could bite. Unlike birds, they can not fly away, and they never meddle with fruit or grain. The pretty leopard-like Holbrookia eats some herbage as well as insects. A baby Holbrookia an inch long will eat an apple worm half an inch long. When put in the flytrap cage these lizards first pick out the very large, black, and bright-colored flies before eating the house flies.

Dipsosaurus dorsalis eats herbage only.

Crotaphytus is a cannibal, eating the young of the horned toads and all kinds of insectivorous lizards. It eats herbage and some insects, but no doubt does more harm than good. The blue-tailed lizards are Cnemidophorus and Utas. Natural enemies are cats, dogs, ground squirrels, and chickens. Rats and snakes are very destructive to the young. These lizards could be shipped to any part of the United States except during the breeding season—the middle of summer—and I think could stand the cold and other climatic conditions.

Little girls and ladies own pet lizards; boys and gardeners kill them. Next fall I expect to be able to report on other groups of lizards. My efforts to introduce them as insect destroyers have failed because towns have not been willing to protect them and destroy their enemies, while private individuals could not protect them.—WINNIE HARWARD, *Albuquerque, N. Mex.*

ON THE RECENT SPREAD OF THE MEDITERRANEAN FLOUR MOTH.

Since the first reported invasion of flour mills by *Ephestia kuehniella* in Ontario, Canada, in the year 1889, the spread of this species in North America has been fortunately comparatively slow. There is no doubt that its further dissemination has been prevented largely through the many notices of its injuriousness and of the precautions to be used against it that have been published in scientific periodicals and other publications, and the progress that has been made in methods for the insect's suppression. It is equally positive that the insect had been present in this country, and in each of the several localities where it was first reported as injurious, some years previous to the dates specified, as it requires usually several years for almost any species of insect to become seriously injurious in a new locality. As an example of this it is only necessary to cite the observation of Danysz, who traced the occurrence of this flour moth in America back to the year 1880, nine years before its reported occurrence in injurious abundance here.

The recorded spread of this species after the first Canadian invasion mentioned is, in brief, as follows: In 1892 it first became destructive about San Francisco, Cal., and is very troublesome there and elsewhere in that State even at the present time, in spite of the most approved methods that have been devised and put in use for its destruction. In 1893 its occurrence was noticed, though not in flouring mills, at Loveland, Colo., on honeycomb, the larvæ seeming to feed on pollen in the cells (C. P. Gillette, Bul. No. 47, Colo. Agl. Expt. Sta., pp. 50, 51).

In May, 1895, its appearance was noted in mills in southwestern New York State, presumably near the Pennsylvania State line. Although the locality has not, to my knowledge, been published, correspondence between the miller and Prof. W. G. Johnson, who first reported this outbreak in a milling journal in May, 1895, elicited the information that the species had been present in that locality at least since 1893. Later the species occurred in Pennsylvania. In both these localities it was injurious in flouring mills.

Very recently the pest has been discovered in Ohio, in Stark County, as well as in various new localities in States where the species has been previously observed. These localities have been given by Professor Johnson in recent publications.

We have now to record the occurrence and probable establishment of this pest in Minnesota, in the very center of the most extensive milling plants in this or any country.

October 12, 1898, Prof. H. L. Osborn, Hamline University, St. Paul, Minn., sent to the United States Department of Agriculture larvæ of this species, from which the imago was subsequently reared, taken in flour. It came to a laboratory at Hamline University in a sack, and was transferred to an empty barrel, where it had remained since the preceding June. The previous history of the barrel was not known, and could not be traced. Professor Osborn, however, wrote us, under date of October 19, that the flour was purchased in St. Paul in April of that year, and was not opened until fall, as the house was closed during the summer, while the owner was absent. About the middle of September the servant began to use the flour, and from what our correspondent writes, it seems probable that there was every chance that some of the larvæ made their escape. As soon as Professor Osborn became acquainted with the identity of the insect he killed all of the larvæ that could be found, so that there could be no possibility of their escaping and developing; but it is possible that some of them had already made their escape before this time.

Nothing further has been learned concerning this occurrence, but it is believed best to bring the matter to public notice, so that millers in the vicinity of St. Paul and Minneapolis may be forewarned, and hence the better able to cope with this insect should it make its appearance in their mills and warehouses. The fact that it is the most pernicious of all mill insects is well established, as well as that it is capable of developing upon all sorts of ground cereals.

In addition to the localities mentioned above, this species has been recorded from North Carolina, Alabama, and New Mexico, but evidence is wanting to show that its occurrence in these States is in mills, or that it is established there otherwise than in the open. It is known to live in the nests of wild bees, and in the three States last mentioned it may not even occur in the vicinity of mills or storehouses.—F. H. CHITTENDEN.

NOTE ON TWO SPECIES OF "LIGHTNING HOPPERS."

During the past two years two species of hoppers of the family Fulgoridæ have been noticed in considerable numbers on useful plants in the District of Columbia and near-by points of Maryland and Virginia. One of these, *Ormenis* (*Pœciloptera*) *pruinosa*, or the frosted lightning hopper, as it has been called, is new to the list of apple insects as recently revised by the late Dr. Lintner, while *Chlorochroa* (*Flata*) *conica* has not been mentioned in the list of grape insects published by Prof. Lawrence Bruner (Rept. Nebr. State Hort. Soc. for 1895, pp. 69–72).

Both species are reputed to weaken and distort the young and tender shoots and other growth of their food plants by the innumerable minute punctures which they make for the deposition of their eggs and for food, and both have the singular habit of congregating in rows or ranks of half a dozen or more on the vines or tree twigs which they infest. When disturbed all the individuals retreat to the opposite side of the vine or twig in almost as complete unison as a squad of soldiery.

Ormenis pruinosa Say.—Nymphs nearly full grown and a few adults of this species were found during the last week of June, 1899, upon apple at Cabin John, Md. Some were upon the leaves and some upon the stems of the fruit. They readily attract attention by the soft white flocculent substance which is secreted and forms in a light mass about the nymphs and which remains for some time after the nymphs have issued as perfect insects and gone to some other portion of the plant. Nymphs and adults were also found in great abundance on plum, both at this place and in the District of Columbia, as well as on cherry, potato, three-sided Mercury (*Acalypha virginica*), virgin's bower (*Clematis virginiana*), and trumpet creeper (*Tecoma radicans*). Although a general feeder this species appears to favor climbing plants.

This hopper has received rather frequent mention in different economic, including governmental, publications. The first of these that I find is by Miss M. E. Murtfeldt (Bul. No. 13, o. s., pp. 61, 62), in which special reference is made to destructiveness to foliage and stalks of dahlia at Kirkwood, Mo., in 1886. In one garden plants were injured beyond recovery. In volume IV of Insect Life (p. 142) brief notice is given of reported ravages on so-called "California hedge plant" in Texas. In volume V of the same publication (p. 155) it is mentioned briefly by Miss Murtfeldt among the enemies of Osage orange, and in Bulletin No. 32 (p. 38) the same writer states that the insect was remarkably abundant in 1893 in vineyards in Missouri, where it was popularly mistaken for "mealy bug," and that it caused considerable blighting of the leaves and twigs. A still longer account was given in the Fifth Report of the United States Entomological Commission (p. 281) from notes by Professor Riley, the food plants mentioned including elm, hackberry, maple, red clover, and *Erigeron canadense*. Illustrations of the species and a short account of its habits and of the method of its attack on sassafras were given by the same writer in his Fifth Missouri Report (p. 122).

Chlorochroa conica Say.—This beautiful green species was taken in some numbers at Colonial Beach in July, 1897. The adults fed upon grape, and it was reared from nymphs found on the same plant. Its favorite food plant was not grape, but hop, and its occurrence on grape was due to an overflow from the hop vines upon which it was present in large numbers.

This species has also been recorded as occurring on Osage orange and lilac, the tender shoots of which plant, according to Miss Murtfeldt (Bul. No. 13, l. c.), it weakens in the same manner as does the Ormenis.—F. H. C.

COTTON INSECTS IN EGYPT.

In the May and June numbers of the "Journal of the Khedival Agricultural Society," published at Cairo, Egypt, there is an article by Mr. George P. Foaden on "Insect and other pests injurious to cotton in Egypt." The author deals chiefly with two insects, the cotton worm, *Prodenia littoralis*, and the boll worm, *Earias insulana*.

The Prodenia differs from the Aletia of our Southern States in at least three important points—the moth lays her eggs on one or two leaves only, the pupal period is passed in the ground, and the caterpillar feeds on various crops, as berseem, maize, and barley. There are at least five broods in a season on the cotton. Sometimes, if the cotton is sown on land recently in berseem (a winter forage plant), the stems of the young cotton plants will be eaten close to the ground, thus necessitating replanting. The habit of the moth in placing her eggs mostly on one or two leaves is the clew to the best remedy—the picking of these leaves before the larvæ leave them. About a month after this the cotton should be heavily flooded to destroy any caterpillars which escaped and are now, as pupæ, in the ground. The intelligent use of these two measures prevents any serious damage to the crop.

The Egyptian boll worm (*Earias insulana*), known to us through the writings of Frauenfeld and others, is, like our own form, not so easily controlled. One egg is laid by a moth on a boll, the larva, hatching, gnaws into and destroys the contents of the boll. It passes the winter in a grayish white cocoon which is fastened to the bracts of a flower. No real remedy has been found; the only measure of value is the burning of the cotton wood as soon as possible after the gathering of the crop.

Two other insects are mentioned as of minor importance. One, a plant-louse, *Aphis ulmaræ*, sucking the leaves; the other a Lygæid, *Oxycarenus hyalinipennis*, which infests the bolls damaged by the Earias.—N. B.

A COTTON STAINER IN PERU.

We recently received from Mr. Eduardo Fowks, of Paita, Peru, a bug congeneric with and rather closely resembling the well-known cotton stainer of the Southeastern United States (*Dysdercus suturellus*), a full account of which was published in Insect Life (Vol. I, p. 234), and which was further mentioned in the writer's account of insects affecting the cotton plant (U. S. Dept. of Agric., Farmers' Bulletin, No. 47). The Peruvian insect, which proves to be *Dysdercus ruficollis* Linn., has the same habits as our North American species, piercing the bolls and staining the cotton, reducing the value of the cotton, according to Mr. Fowks, "from 4 to 6 cents a pound." The common name (presumably Indian) is Rabi atadi, which signifies "tails tied together," the name being given from the fact that the adult insects are usually found attached in this way. During 1898 the damage to two cotton plantations at Paita from this insect was at least $10,000.

BIOLOGIC OBSERVATIONS ON HARPALUS PENNSYLVANICUS DEG.

One of the commonest insects over a wide extent of territory in this country is the ground beetle, *Harpalus pennsylvanicus* DeG. In the late Dr. Riley's First Missouri Report (p. 59) the adult of this species is figured, as also a larva, which latter is fully described and which was

believed to probably be the same species. Since the publication of that report in 1868, the same species has received frequent mention in reports and other publications of Dr. Riley, as also by many other economic entomologists. The species has in some way gained general credit for being efficient as a destroyer of injurious insects, but, to the best of the writer's knowledge, its exact economic status has never been clearly defined. The observations which will be here presented, although not bearing upon this subject to any considerable extent, are of interest as being, perhaps, the first actual observations on the living habits of the larva. From the fact that the larvæ were found so deep under ground, and in the absence of other species that might have served for food, it would seem not improbable that they subsist to a considerable extent upon angleworms rather than on the larvæ and pupæ of other insects. A comparison with the illustration and description of the larva mentioned in the First Missouri Report and used the same year in the American Entomologist (Vol. I, p. 34), show that this is not *Harpalus pennsylvanicus*, the color alone being sufficient to exclude it, but is perhaps Pterostichus or a related genus, as pointed out in volume V of Insect Life (p. 209). The species treated by Riley in the First Report of the U. S. Entomological Commission (p. 290, fig. 24) is, however, plainly a Harpalus, or at least a closely related genus, and perhaps *H. herbivagus* Say, a smaller species than *pennsylvanicus*, and undoubtedly differing to a considerable extent in structural details and, perhaps, also in habits, judging from the fact that the hypothetical *herbivagus* is much darker than *pennsylvanicus*. The latter is nearly white throughout, indicating an almost exclusively subterranean habit.

April 8, 1898, while preparing a little plat of earth for experimental purposes on the Department of Agriculture grounds a single larva and two adults of *Harpalus pennsylvanicus* DeG. were found by Mr. F. C. Pratt at a considerable depth below the surface. The digging of the earth began at the southeastern corner of the grounds and proceeded northward, the work extending over portions of three days. On the second day numerous pupæ and only a single larva were found, and on the third day in the northern end of this plat, which was bordered at this side by a driveway and high hedge of evergreens, an abundance of larvæ were taken, with only one or two pupæ. The last larvæ dug up were the smallest and least mature. The most mature individuals were found on the southern end of this plat and the least mature on the northern end. Still another point was noticed, namely, that the insects occurred for the most part within about 2 or 3 feet of an Osage-orange hedge nearest the sidewalk. Nearly all of the larvæ and pupæ dug up—about 40 in number—were found at a depth of 9 or 10 inches, and with the exception of three individuals—beetles and larvæ taken on the first day—were within about 20 feet of the hedge and trees bordering the driveway. These details, although, perhaps, inconsequent in themselves, are mentioned, as the occurrence of the insects in the manner narrated was as noticeable as it is unexplainable.

The larvæ that were kept under observation burrowed into the soil with which they were provided and remained there until the advent of a warm spell, which happened April 17, when they came up from the earth, evidently in search of food.

The pupal cells observed were in most cases rather crude, but some few were fairly well defined—one such which will prove a fair sample of the best, measuring about 20mm in length, half that in width, and nearly as deep as wide.

A larva that was kept under observation transformed to pupa April 15 and the imago appeared May 15, this individual having remained as pupa thirty days.

From the species figured and described by Riley as *H. herbivagus*, this larva may be distinguished by size alone as well as by color and form, but it also agrees in many particulars. It is about a third longer, measuring 0.85 inch (11 to 12mm) as against 0.58 inch for *herbivagus*. The abdomen does not taper strongly, all of the segments except the last three being of similar width to the head and thorax. The color is white, the thorax being bright yellowish, but little darker than the body. The mandibles are dark brown and the single strong median tooth is black. The body is clothed with short yellowish hairs in the same manner as *herbivagus*, but these are more sparse than in the figure of that species.

One of the pupæ taken April 9, while being placed in alcohol, gave forth a parasitic larva, evidently dipterous, which crawled out from the under surface of the body near the legs of its host.—F. H. C.

A NEW WESTERN ENEMY OF THE COLORADO POTATO BEETLE.

Mr. J. A. Green, Waynoka, Okla., has sent us specimens of the soldier bug *Perillus claudus* Say, with the accompanying information made under date of September 16, 1899, that the species is an enemy of the Colorado potato beetle. He writes as follows:

These bugs appear during the month of May. They have a bill that lies close to the under part of their body when not in use. They deposit their eggs (which are black) on a potato leaf. The body of the young bug is a bright red and the head is a dark blue, almost black. As they grow they keep shedding their skins and changing in appearance until they are grown. The young bugs commence feeding on the eggs of the potato bug. They insert their bill in the end of the egg and suck the juice. One little bug will commence on a nest of potato-bug eggs and never stop until he has sucked the last egg. The bugs, both young and old, stick their bills into the young potato bugs, and when these are scarce they do not hesitate to tackle old ones. They do not stop at potato bugs, but suck all the miller or moth eggs they find, and even destroy the worms after they hatch. I saw them last spring with worms on their bills two or three times as large as themselves.

Worms of different kinds are very destructive to tomato vines in Oklahoma. Last spring I placed one nest of this bug's eggs in my tomato patch, and, for two months, or until the bugs left, I was not troubled with worms of any kind. It was here that I first noticed them destroying worms. There is a similar bug, belonging to the same family, perhaps, that destroys the moth, eggs, and worms in the kafir corn in the same way. If we only had some means of protecting these valuable insects

through the winter they would prove very useful to the farmer. During their breeding season the soldier bug possesses a voracious appetite, carrying a bug on his bill most of the time. During the fall and winter they live hidden away in dry places and seem to eat nothing. Many of them hide away in houses. I found the accompanying specimens in the house. The male and female are marked a little different, the male being red where this one is yellow.

NOTES ON MISCELLANEOUS INSECTS IN KANSAS.

Under date of December 11, 1899, Mr. F. F. Crevecœur, of Onaga, Kans., wrote that on June 9 of that year he observed an individual of the histerid beetle, *Paromalus estriatus*, feeding upon a box-elder plant-bug (*Leptocoris trivittatus*). The same day he saw a specimen of the robber fly (*Dasyllis tergissa*) feasting on a honey bee. July 16 a specimen of "granddaddy long-legs" (*Phalangium ventricosum*) was seen attacking a blue wasp, *Chalybion cœruleum*, in his house. It had nearly devoured the abdomen, but whether it had killed the wasp or found it already dead was not ascertained. July 20 the large ground beetle *Pasimachus punctulatus* was observed while carrying off a smaller ground beetle, *Anisodactylus verticalis*, that it had just killed. August 20, *Mordella scutellaris* was reared from a yellow pupa about a quarter of an inch in length, which was taken August 14 in the stem of *Amaranthus chlorostachya*. The Pyralid moth, *Titanio octonalis* Zell., was reared from larvæ taken June 20, feeding on *Onosmodium carolinianum;* the imago issued June 29.

As to the reported statement by us in Farmers' Bulletin No. 99 that the white-marked tussock moth (*Orgyia leucostigma*) had not yet made its way west of Iowa, so far as known to our Department, Mr. Crevecœur wrote that in 1898 two or three larvæ were observed hanging from trees at Onaga, Kans., and in 1899 two adults were reared from larvæ on box-elder, and that as long back as 1890 this species was very plentiful on walnut trees in that vicinity. Onaga, it should be mentioned, is not farther west than Lincoln, Nebr., a locality also recorded by us for this insect.

Concerning the peculiar buzzing noise made by the large ground beetle (*Harpalus caliginosus*), by stridulation, our correspondent wrote that it was several times observed during the summer. The habit is now well known, but it is seldom that one has the opportunity of hearing this singular noise for himself.

AN EMBARRASSING FEATURE OF FOREIGN INTERDICTION AGAINST AMERICAN PLANTS AND FRUITS.

It appears from a dispatch from the United States consul at Geneva that the vineyards in the Canton of Vaud, the greatest wine-producing section of Switzerland, have suffered greatly during the year 1899, as well as 1898, from the grapevine Phylloxera, and that the vine-growers of all French Switzerland are greatly concerned over the present situation. The grand council of the Canton of Vaud has recommended the

planting of American vine stock throughout the wine-growing territory. Under the present laws American vines can not be introduced into the country, but the grand council will ask the Confederation to permit the introduction of such vines under strict governmental inspection.

THE GREEN JUNE BEETLE OF THE SOUTHWEST.

Writing under date of August 31, 1899, Dr. R. E. Kunzé, Phœnix, Ariz., calls attention to the injuries inflicted by the Western green June beetle (*Allorhina mutabilis* Gory) in southern Arizona. This species has received some mention in Insect Life, and more particularly by Mr. Townsend in Bulletin No. 5 of the New Mexico Agricultural Experiment Station, page 10, where it is stated to be extremely injurious to ripe peaches, apples, pears, figs, grapes, and other fruits.

The following is an abstract of Dr. Kunzé's letter:

A few words about the Scarabæid *Allorhina mutabilis*, which periodically appears in great numbers in southern Arizona to the detriment of deciduous fruit trees and vines. My observation is based upon a continuous residence of three and a half years during closed season (December, January, and February) of each year. This pestiferous insect destroys the first fig crop of the year in southern Arizona. Next to the fig, this beetle attacks grapes. Peaches, apricots, nectarines, pears, and apples are in turn destroyed, the last two fruit trees the least of any. While in Tucson, season of 1897, Mr. Elliott, ex-postmaster, told me that his crop of garden grapes was annually destroyed by *mutabilis*. He picked off the beetles as fast as he could, and within two days beetles and berries were alike gone. Other residents related the same story concerning their fig crop.

In the early summer of 1898 in Phœnix I observed *mutabilis* hanging to a single fig in clusters the size of a folded pair of hands, and when the stem was eaten off would drop to the ground, flying in every direction.

Mr. S. M. Barrows, of Tombstone, whose family camped with me in the Huachucas during July, 1899, informed me that his grapes were usually eaten up by *mutabilis*.

A NOTE ON THE COCKLEBUR BILL-BUG.

One of the insects figured and treated by the late Dr. Riley in his Third Missouri Report (p. 60) and in the report of this Department for 1881–82 (p. 142) is the gayly-colored red and black snout beetle, *Rhodobænus 13-punctatus* Ill.

This species is said to attack cultivated sunflower, but as neither this nor any other stem borers that attack the large-stemmed composites have any apparent effect on the vitality of the plant the species can hardly be said to be of economic importance either as a destroyer of cultivated plants or of weeds. The insect is, however, of interest by reason of its near relationship to the genus Sphenophorous, many species of which are injurious to corn and other Gramineæ, and and are known generally throughout the country as corn bill-bugs.

Two imagos and one pupa were taken recently during September near Rosslyn, Va., from the stems of the Joe-Pye weed (*Eupatorium perfoliatum*) a single individual in each stem. Several other stems which comprised this clump were opened, all of which betrayed un-

mistakable evidence of having been recently tenanted by this species, the accumulated castings and the size of the exit hole indicating the nature of the late occupant. In almost every stem there was equal proof of the presence of a second tenant, viz., *Languria mozardi*, the latter occupying the upper portion of the stem, the Calandrid the lower. The species was also found breeding in the stems of the so-called large-flowered leaf-cup (*Polymnia uvedalia*) at Marshall Hall, Md.

Other food plants that have been recorded for this insect belong to the genera Xanthium, Helianthus, Cirsium, Ambrosia, and Silphium. Some time ago Rev. G. D. Hulst informed me that this species also breeds in the stems of Vernonia, and it seems probable that it will thrive in all the Compositæ if not also on some other plants which have stems of sufficient size and structure for its occupancy.

The hibernated imagos appear in the neighborhood of the District of Columbia as early as the first week in May, and the newly bred imagos have been found the first week of September.

Two parasites of this species have been observed by the writer. The first of these is the chalcidid *Habrocytus rhodobæni* Ashm., reared from material from Rosslyn, Va., and described in 1896 (Tr. Am. Ent. Soc., Vol. XXIII, p. 220), and the other, also a chalcidid, is undescribed.—F. H. C.

REPORTED INJURY BY GIANT SCARABÆID BEETLES.

July 27, 1899, we received through Prof. F. S. Earle, Auburn, Ala., specimens of both sexes of *Strategus antæus*, a relative of the well-known rhinocerus beetle *Dynastes tityus*, with an inclosure from Mr. C. W. Ewing, Gadsden, Ala., who reported severe injury by these beetles to orchard trees, particularly peach. A specimen of the root of one of these trees accompanied the letter, which showed the gnawing of some animal. Mr. Ewing seems to be positive that beetles were the cause of the injury. No such instance of injury by this species has apparently been recorded, but it is not impossible that it may have been done under the most exceptional circumstances, as, for instance, in a locality where many dead roots would afford breeding places for the beetles. A similar instance of injury was reported by our correspondent on the authority of his brother, who noticed these beetles upon peach trees at Chattanooga, Tenn.

April 29, Mr. S. C. Gibson, of the University of Virginia, wrote that *Xyloryctes satyrus*, another related species, attacked ash in his vicinity, and after boring a hole under the surface of the ground to the depth of an inch or two "seemed to destroy the bark all around the tree."

LOCUSTS IN ARGENTINA AND LOURENÇO MARQUEZ, SOUTHEASTERN AFRICA.

Through Mr. James W. Ayers, United States consul at Rosario, Argentine Republic, the Department has received, by courtesy of the Department of State, a clipping from the Standard, of Buenos Ayres

of August 27, 1899, stating that there is every prospect that during the coming season (this winter) there will be a locust invasion in great force. The statement is made on the authority of Mr. Oliver C. James of Carcarañá, who is said to be one of the best authorities in the Argentine Republic on questions relating to locusts. Mr. James calls attention to the fact that the permanent breeding grounds of the South American locust in Uruguay are neglected, and emphasizes the fact that money spent in invaded regions is absolutely thrown away unless supplemented by coordinate efforts in Uruguay.

A report from Mr. W. Stanley Hollis, United States consul at Lourenço Marquez, in the southeastern part of Africa, transmitted in the same way and dated August 24, states that during that month the town was twice visited by dense swarms of locusts which did considerable damage and left the roofs of the buildings in a filthy condition, thereby necessitating much extra cleaning. As all of the drinking water is drained from the roofs and stored in iron tanks, the pollution by locusts is a serious matter, as locust droppings are most offensive. This is a new aspect of locust damage.

A NEW CLOTHES-MOTH REMEDY.

Dr. A. K. Fisher, of Washington, uses bisulphide of carbon against clothes moths. He has a wooden chest in which he stores away his clothes. In the cover of the chest he has a large auger hole, with a sponge tied immediately below it. In midsummer he pours a few drops of bisulphide of carbon through the auger hole upon the sponge and closes the hole with a cork. He states that by virtue of this treatment he has never had any moths in his clothes.

NOCTURNAL FLIGHT OF GRASSHOPPERS.

The following interesting note has been sent to this office by Dr. H. M. Smith, of the United States Fish Commission:

> On July 12, 1899, between 11 and 12 o'clock at night, there was a remarkable flight of grasshoppers at the light house in Lake Erie off the mouth of the Detroit River. The insects were of large size and very numerous, the platform around the lantern being thickly covered with them. The keeper aroused his assistants and had them sweep the grasshoppers from the platform, a number of pailfuls being removed. Although grasshoppers have occasionally appeared at this light house in the daytime this is the first instance of a night flight. The light is one of the most powerful and conspicuous on Lake Erie.

After comparison with named specimens in Washington, Dr. Smith, from recollection, seems reasonably sure that the species was the American locust (*Schistocerca americana*). This species is a strong flier, and, while it breeds only farther south, has been occasionally taken in Ontario. This remarkable flight noticed by Dr. Smith will account for the Canadian occurrences of this species.

NOTES FROM CORRESPONDENCE.

Habits of Atta insularis Guerin in Cuba.—A correspondent, Mr. A. M. Yznaga, sending specimens of a leaf-cutter ant, *Atta insularis*, writes that these insects were introduced some years ago into the hills of another rather destructive ant, and proved to be even more injurious than the original species, since they did considerable damage to young poultry, and, in fact, to all young domestic animals. He writes further: "I remember that my father some years ago was advised to propagate this ant in his cane fields, where mice and worms were doing great depredations to the sugar cane. That evil was most effectually stopped, but, on the other hand, the estate was ruined for several years for breeding purposes. Even newly born children had to be watched, otherwise they would be bitten to death or have their eyes severely injured. In 1869 I visited the place with the idea of turning it into a cattle ranch, and had to give it up. The ants were so numerous that they actually would put out burning charcoal. A hole was dug in the ground and embers put into it; so many would crawl over them that they would extinguish the fire. In 1876 they disappeared from the estate."

A New Name for an Old Insect.—Under date of June 28, 1899, we received from a correspondent at Princeton, Iowa, a letter of inquiry in regard to what he calls "the new potato beetle or fly," on potatoes, which from the description was undoubtedly a blister beetle. The insect was said to be very destructive, taking the place of the "old-style potato bug," by which our correspondent undoubtedly referred to the Colorado potato beetle. Soon after the advent of the latter species in the East the blister beetles became known as the "old-fashioned potato beetles," and it is one of the strange reversals that sometimes happen that has led to the Colorado potato beetle being now called "the old-style potato bug," while the original potato destroyers are known as "the new potato beetles."

Injury by Wingless May Beetles in Texas.—May 22, 1899, Mr. G. G. Hood wrote from China Springs, Tex., that the distended May beetle, *Lachnosterna farcta* Lec., specimens of which were sent, was doing injury to collards in that vicinity. The beetles were observed to be working at night from dark until about 10 o'clock, when they deserted the plants and entered the ground to a depth of about 4 inches. They were first observed by the 1st day of March and had visibly decreased in numbers after the 1st of May. Young plants they devoured completely; older plants they defoliated, leaving the main stalk. Another May beetle, *Lachnosterna lanceolata* Say, was also found to attack collards and was noticed more or less every year since 1890. Their principal food was stated to be "careless weed" (Amaranthus), two or three species of which grow commonly in or near cornfields.

The New York Weevil in Virginia.—Writing of the so-called New York weevil, *Ithycerus novaboracensis* Forst., in 1871, the late Dr. Riley said that this beautiful beetle often did considerable damage to fruit trees and that he was receiving it every spring from persons who desired information concerning it. Evidently since that time the species has for some reason been on the decrease, as no cases of injury have been reported to this division since June of 1879, when damage was observed to fruit trees in southern Illinois.

May 22, 1899, Mr. George W. Sandefur, Sidna, Carroll County, Va., sent specimens of the beetle with the information that the species was destroying his apple trees, cutting off the leaves and twigs of various lengths from 2 to 6 inches. Work was noticed to be done chiefly at night.

The present year injury was noticed at Rome, Ga., to apple and peach trees, as reported by Mr. A. L. Quaintance in a preceding bulletin (Bul. No. 20, p. 58).

Appearance of the Twelve-spotted Asparagus Beetle near New York City.—Writing under date of June 6, 1899, Mr. Richard F. Pearsall states that on the previous day he discovered a colony of the introduced asparagus pest, *Crioceris 12-punctata*, in the outskirts of Brooklyn, the beetles being sufficiently abundant to permit

the capture of some 30 specimens. This is not the first record of the occurrence of the species in New York State, but it does not appear to have been noticed near New York City before this time.

Recent Injury by the Margined Vine-chafer.—June 24, 1899, Dr. E. K. Harding Orange, Va., wrote that this insect, *Anomala marginata* Fab., specimens of which were sent later, was troublesome in that section of Virginia. The beetle was stated to devour the leaves of fruit and other trees and bushes, eating the fruit around the stem so as to cause it to fall off. Injury had never been noticed prior to 1899.

Food Plants of the Blister Beetle (*Henous confertus*).—Under date of June 7,1898, Mr. F. W. Thurow, Harvester, Tex., writes that this black meloid beetle, specimens of which he sends, appears to be a general feeder, but that it takes a special liking to *Amaryllus candida*, an early fall-blooming exotic plant cultivated in this country. At first it keeps the leaves eaten off, afterwards taking the flower stem, and next the flower itself. Mr. Schwarz says that this species also attacks potato, but prefers wild Solanum.

The Original Home and a New Food Plant of the Harlequin Cabbage Bug.—Prof. T. D. A. Cockerell finds at Las Vegas, N. Mex., and formerly at Embudo, N. Mex., that *Murgantia histrionica* occurs abundantly upon a Capparidaceous plant, *Cleoma serrulata*. He thinks, and the editor sees no reason to differ from him, that the Harlequin cabbage bug is probably native to that region, and that the Cleome is its proper food plant, or one of them.

Injury to Strawberries by Myodocha serripes.—June 1, 1899, Mr. T. J. Peyton, Rapidan, Va., sent specimens of the Lygæid, *Myodocha serripes* Ol., with the report that it was very injurious to strawberries by puncturing the fruit. They were observed to attack the berry in all stages of its growth, but did not attack the vine at all. They begin by puncturing the fruit as soon as the bloom drops, and continue until the berry is destroyed. As many as 20 of the bugs could be observed on a single large berry, and hundreds were about each plant. They were stated to increase by thousands daily, and to be destroying our correspondent's entire crop, which gave promise of being very large for the space planted. Vines were stated to have from 50 to 75 green berries on each, and from most of them not a single ripe berry was obtained. The insects punctured the small ends of the green berries, and this appeared to retard their growth, causing them to become small and knotty and, of course, not fit to eat. Attack by this insect of the nature specified has previously been recorded in the same locality by Prof. W. G. Johnson (Bul. No. 20, n. s., p. 63).

Hibernation of the Electric-light Bug.—Mr. H. J. Giddings, of Sabula, Iowa, sent to this office under date of February 4, 1899, an adult specimen of *Belostoma americanum*, which had been found alive under the ice in a creek, the temperature at the time being 10° F. below zero.

The Praying Mantis as an Enemy to the Apiary.—August 20, 1899, Dr. O. M. Blanton, Greenville Miss., wrote that this species, *Stagmomantis carolina*, specimens of which accompanied his letter, was quite often found about his apiary feeding upon the bees. They were stated to devour them as ravenously as a cat would a mouse. Our correspondent was informed that these insects also fed upon house flies.

Mayflies on Lake Erie.—The following note has been received from Dr. H. M. Smith, of the United States Fish Commission:

Capt. John Baxter, of the U. S. light-house tender *Haze*, reports that he has at times sailed through 20 miles of dead May-flies in the middle of Lake Erie.

On July 20, 1899, I found on the flat top of a gas buoy near the national boundary line thousands of dead May flies. About one year ago when I was at the same buoy there were many more May flies on it. The entire top, about 4 feet in diameter, was covered with a mass of May flies fully 2 to 4 inches thick; these had been matted into a compact cake by rain and sun.

A Plant-bug Enemy of the Green Plant-bug.—In Volume I of "Insect Life" (p. 88) the plant-bug *Euthyrhynchus floridanus*, a common southern species, was recorded as having been observed in the act of piercing a honey bee. Many of the plant-bugs feed with apparently equal relish on either plants or insects, and it is often a matter of difficulty to determine the economic status of a species when the insect has this dual habit. As further confirmation of the predaceous habits of this species, we received, under date of January 2, 1899, through Mr. B. M. Hampton, Lakemont, Fla., a specimen from Mr. J. P. Donnelly, Mount Dora, Fla., who captured it in the act of dragging the green plant-bug, *Nezara hilaris*, along the ground. Its long proboscis was found on nearer observation to be inserted in the center of the abdomen of its victim, and the green plant-bug was dead.